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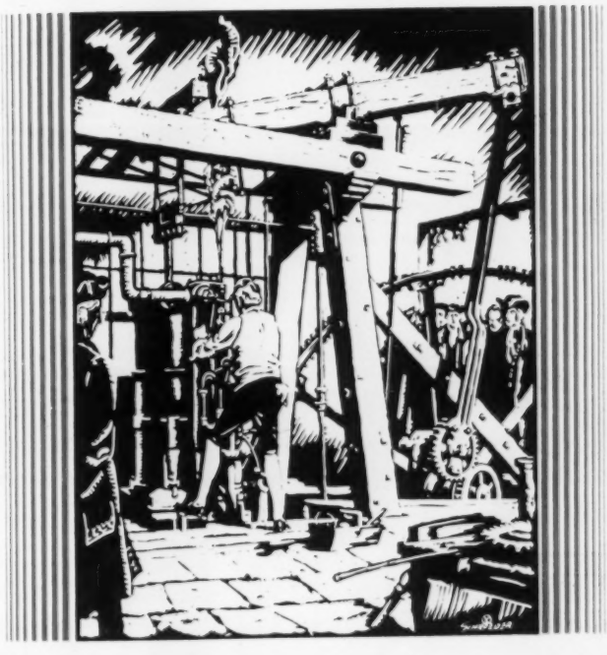
MACHINE DESIGN



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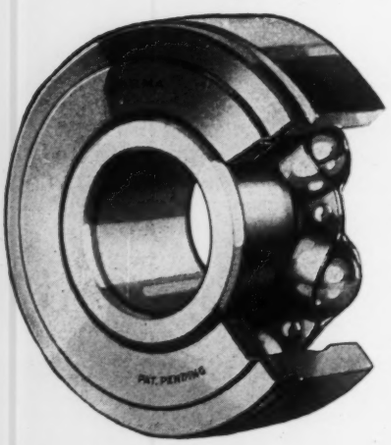

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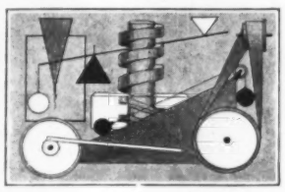
Volume 3 | **January, 1931** | **Number 1**



Next MONTH

SELECTION of working stresses for machine parts constitutes one of those problems which confront almost constantly the engineer engaged in design. Such stresses determine in many cases the life of the machine and obviously therefore should receive thorough consideration.

A discussion to appear in the February issue will be found to be of material assistance in this connection. The contribution has been prepared especially by H. F. Moore, research professor of engineering materials, University of Illinois, who is well known as one of the most eminent authorities in the country on the subject of materials used in engineering.

L. E. Jermy.
Managing Editor

CONTENTS

	Page
What 1931 Shows Are Revealing in Automobile Design *By Austin M. Wolf*	**17**
Scanning the Field for Ideas	**22**
Designing Elliptical Gearing by Simple Formulas *By F. B. Fuller*	**25**
Obviating Mechanical Troubles by Balancing of Parts *By Werner I. Senger*	**29**
Specify Proper Finish and Color for Your Product *By T. J. Maloney*	**33**
Photoelasticity—and Its Application in Design *By R. V. Baud*	**37**
Single Versus Multiple Motor Drives *By P. W. Arnold*	**41**
When Will Lubrication Cease to Be a Maintenance Problem?	**44**
Professional Viewpoints	**46**
There's Much To Be Learned from the Other Man's Field (Editorial)	**48**
A Century in Locomotive Design	**49**
Noteworthy Patents	**50**
Assets to a Bookcase	**53**
Topics of the Month	**54**
Men of Machines	**56**
Leaders in Design, Engineering and Research	**57**
How Is Business?	**59**
New Materials and Parts	**60**
Manufacturers' Publications	**72**
Business and Sales Briefs	**76**
Calendar of Meetings and Expositions	**14**

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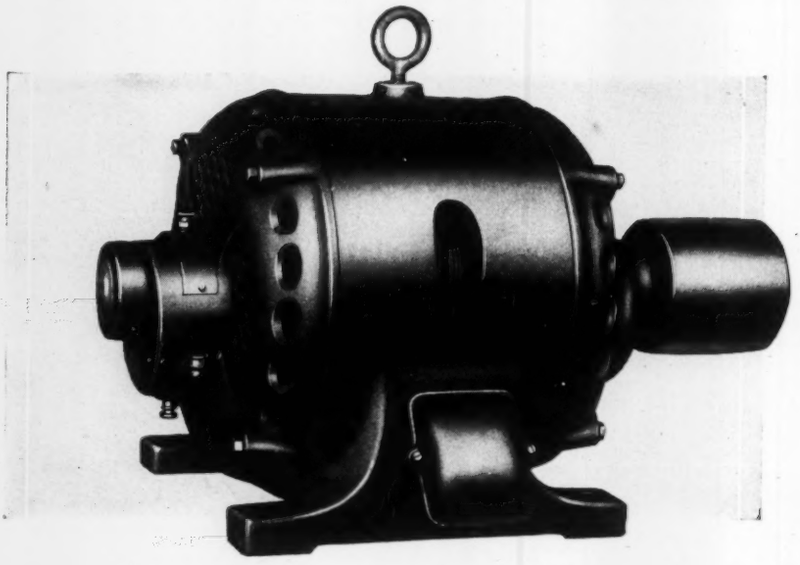
THEY KEEP A-RUNNING



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Itemized Index, January, 1931

Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column

Compiled for the assistance of engineers confronted with specific design problems

Design Calculations:
- Equipment for, Adv. 80 L
- Elliptical Gearing, Edit. 25, 26, 27, 28

Design Problems:
- Applying Motor Drives, Edit. 41, 42, 43
- Choosing Color and Finish, Edit. 33, 34, 35, 36
- Combating Torsional Vibration, Edit. 18 R, 19 L
- Considering Comfort, Edit. 17, 24
- Determining Stresses in Parts, Edit. 37, 38, 39, 40
- Effecting Balance of Rotating Parts, Edit. 29, 30, 31, 32
- Eliminating Noise, Edit. 18 R, 23 R, 24
- Increasing Rigidity, Edit. 21
- Insuring Continuous Operation, Edit. 22
- Meeting Expansion Due to Heat, Edit. 18 L
- Providing Speed Variation, Edit. 25, 26, 27, 28
- Reducing Wear, Edit. 18 L

Finishes:
- Proper Specification of, Edit. 33, 34, 35, 36, 47

Materials:
- Alloys (Iron), Adv. 13
- Alloys (Nickel), Edit. 18L; Adv. 11
- Cork; Adv. 65
- Steel (Chrome Nickel), Edit. 45; Adv. 15
- Steel (Cold Finished); Adv. 15
- Tantalum, Adv. 76 L
- Zinc; Adv. 83

Mechanisms:
- Free-Wheel, Edit. 20 L
- Transmission Units, Edit. 20

Organization and Equipment:
- Of Engineering Department, Edit. 46, 47 L, 70; Adv. 79

Parts:
- Bearings, Edit. 45, 53; Adv. 2, 10, 61, 67, 70 L, 75, 80 L, 82
- Controls (Electrical), Edit. 62 L, 64 L, 66 R, 68 R; Adv. 8, 9
- Couplings, Adv. 78 L
- Drives, Edit. 64 R, 66; Adv. 3, 69, 73, 74 L, 84
- Fastenings, Edit. 62 L; Adv. 16, 81
- Gears, Edit. 20 L, 25, 26, 27, 28; Adv. 68 L
- Heating Units, Edit. 62 R
- Joints, Edit. 20 R
- Lubricating Equipment, Edit. 21, 44, 45
- Motors, Edit. 41, 42, 43, 60 L, 64 R; Adv. 6, 63
- Packing Glands and Packing, Adv. 4, 71
- Pulleys, Edit. 32
- Pumps, Edit. 60 R
- Stampings, Edit. 21; Adv. 77
- Welded Parts, Edit. 39; Adv. 12

Standardization:
- Chrome Nickel Steel Symbols, Edit. 45
- Motors and Generators, Edit. 43

"MAN is a Tool-using Animal. Weak in himself, and of small stature, he stands on a basis, at most for the fattest-soled, of some half square foot, insecurely enough; has to straddle out his legs, lest the very wind supplant him. Feeblest of bipeds! Three quintals are a crushing load for him; the steer of the meadow tosses him aloft, like a waste rag. Nevertheless he can use Tools, can devise Tools; with these the granite mountain melts into light dust before him; seas are his smooth highway, winds and fire his unwearying steeds. Nowhere do you find him without Tools; without Tools he is nothing, with Tools he is all."

CARLYLE:
"Sartor Resartus," Chap. IV

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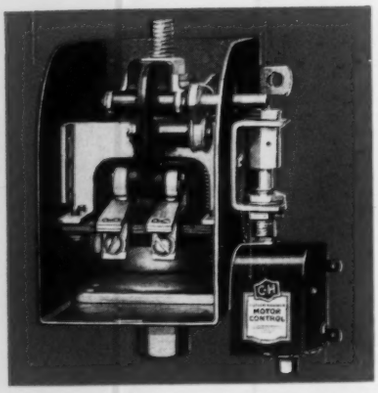

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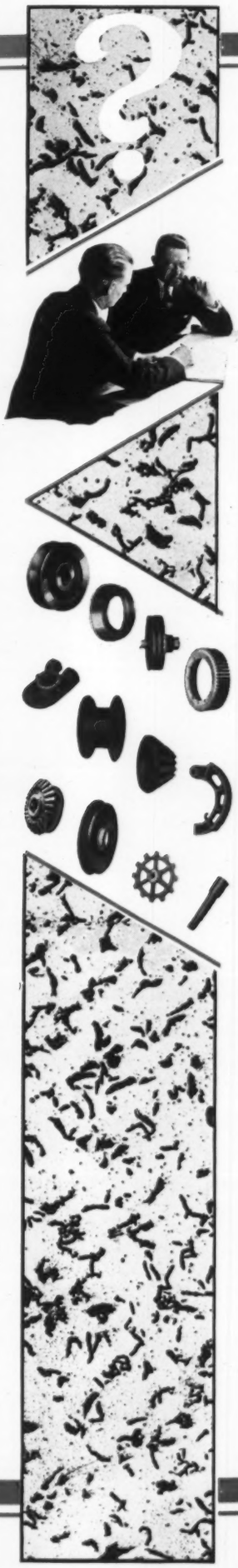

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261

CALENDAR OF MEETINGS AND EXPOSITIONS

Jan. 15-17—American Engineering council. Annual meeting to be held at Mayflower hotel, Washington. L. W. Wallace, 26 Jackson Place, N. W., Washington, is secretary of the organization.

Jan. 19-23—Society of Automotive Engineers. Scheduled to discuss subjects in 12 important fields, 35 outstanding automotive engineers will appear at the 5-day annual meeting to be held at Book-Cadillac hotel, Detroit. A paper on "Torsional Vibration Dampers," by J. P. DenHartog and J. G. Baker, will be one of the features of the engine session. Oil coolers and oil cooling are among the topics to be considered at the fuels and lubrication session. The detonation session will be in the nature of a symposium. Papers at the general development session will include, "The Use of Rolled Zinc and Zinc Base Die Casting Alloys in the Automobile Industry," by Robert M. Curts, New Jersey Zinc Co. "Practical Experience with Devices for Damping Torsional Vibration," by J. Barraja Frauenfelder, will be one of the interesting papers at the diesel engine meeting. Machine tool obsolescense also will be discussed and the transportation, maintenance, and aircraft sessions have important papers scheduled. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary of the society.

Jan. 23—National Association of Engine and Boat Manufacturers. Meeting in New York.

Jan. 26-29—American Society of Heating and Ventilating Engineers. Annual meeting at William Penn hotel, Pittsburgh. A. V. Hutchinson, 51 Madison avenue, New York, is secretary of the organization.

Jan. 26-30—American Institute of Electrical Engineers. Annual winter convention to be held in New York. F. L. Hutchinson, 33 West Thirty-ninth street, New York, is secretary of the organization.

Jan. 29—Steel Founders' Society of America. Annual meeting and election to be held at Hotel Hollenden, Cleveland.. G. P. Rogers, 932 Graybar building, New York, is managing director of the organization.

Feb. 4-6—Engineering Institute of Canada. Annual meeting to be held at Windsor hotel, Montreal, Que. R. J. Durley, 2050 Mansfield street, Montreal, is secretary of the organization.

Feb. 10-14—Midwestern Power Show. The fifth midwestern power engineering conference and exposition, generally known as the Chicago Power show, to be held at the Coliseum in Chicago. Further information may be obtained by addressing the Midwestern Engineering exposition, 308 West Washington street, Chicago. Concurrently the Fourth National Fuels meeting of the American Society of Mechanical Engineers will be held at Stevens hotel, Chicago. Wednesday and Thursday sessions will parallel sessions of the Power conference. R. R. Leonard is field secretary.

Feb. 16-20—Western metal congress. Second National Western Metal congress and exposition to be held in Civic auditorium, San Francisco, under the auspices of the American Society for Steel Treating. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is secretary.

Feb. 24-27—Southwest Road Show and School. Sixth annual event at Wichita, Kan.

March 16-22—Oil Equipment and Engineering Exposition. A technical and scientific gathering of latest developments in machinery and instruments of the oil industry to be held in Los Angeles. Various technical societies are planning meetings in connection with the exposition. E. G. Lenzner, Box 781, Vernon station, Los Angeles, is manager of the affair.

April 12-16—American Society of Mechanical Engineers. Joint national meeting of the materials handling and management division to be held in Cleveland at the time of the industrial equipment exposition. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary of the society.

April 13-18—Second National Industrial Equipment Exposition. To be held at the public auditorium, Cleveland. G. E. Pfisterer, 308 West Washington street, Chicago, is managing director.

April 20-23—American Society of Mechanical Engineers. Semiannual meeting at Birmingham, Ala. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary of the society.

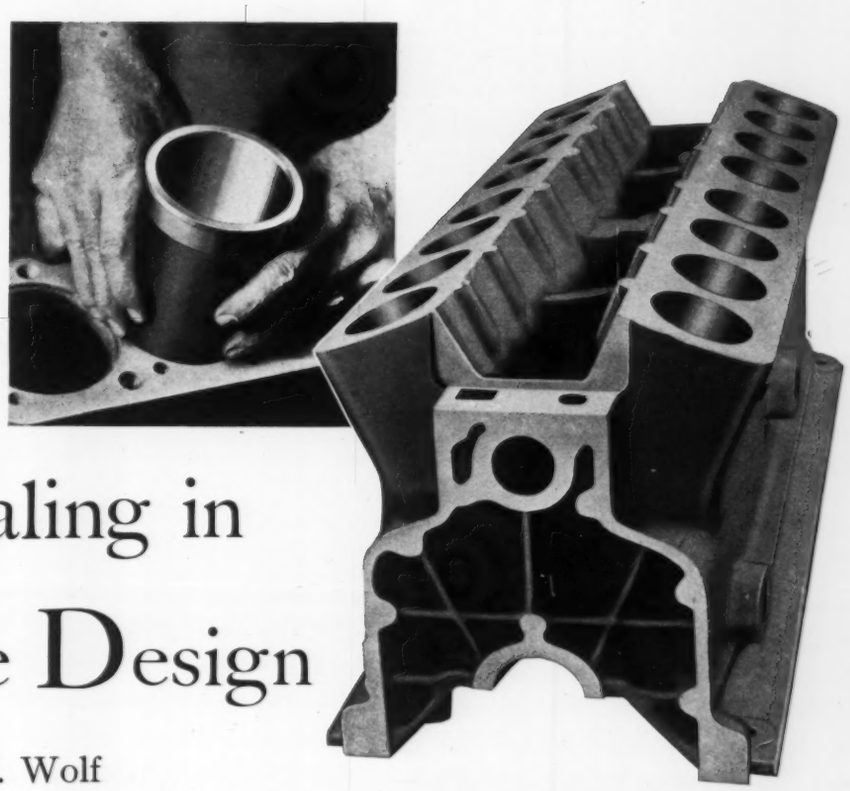
May 4-8—American Foundrymen's association. 1931 annual convention and exhibition to be held at Stevens hotel, Chicago. C. E. Hoyt, 222 West Adams street, Chicago, is secretary of the organization.

May 7-9—American Gear Manufacturers' association. Annual spring meeting to be held at Hotel Statler, Buffalo. T. W. Owen, 3608 Euclid avenue, Cleveland, is secretary.

June 8-12—National Electric Light association. Fifty-fourth convention and exposition to be held at the municipal auditorium, Atlantic City, N. J. Frank H. Gale, 420 Lexington avenue, New York, is secretary-treasurer.

MACHINE DESIGN
THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO
January, 1931 Vol. 3—No. 1

What 1931 Shows Are Revealing in Automobile Design



By Austin M. Wolf
Automotive Consulting Engineer, Newark, N. J.

Figs. 1 and 2—Steel liners are inserted in cylinder block which is cast integral with upper half of crankcase

JANUARY marks the inauguration of the automobile show season and it is natural that our interests should drift in the direction of automobile design. There probably is no other piece of mechanism that is more fascinating due not only to the wide scope of the principles of mechanics, chemistry and electricity involved but also to the fact that the solution of the design problems and methods of fabrication can be applied advantageously to many other industries.

At one time it was thought possible to design a small, inexpensive car by making "short cuts" through the field of conventional construction but while such vehicles would run, the public did not accept them because comfort, appearance and performance were lacking. Many other devices have suffered this experience and the designer is cautioned against being too rabid a reformer. Far more can be accomplished by designing for ease of production and simplification while retaining the essential fundamentals.

The foregoing thought is borne out by comparing the two extremes of motordom: the Baby Austin and the Mathis with the sixteen-cylinder Marmon and Cadillac. They are complete automobiles and differences in design are chiefly the result of relative scale. The four-cylinder engine of the Baby Austin has a bore and stroke of 2.2 and 3 inches, a piston displacement of 45.6 cubic inches, and it develops 14 horsepower at 3200 revolutions per minute. The new Marmon 16 is the most recently designed and largest passenger car engine on the American market. Its cylinders measure 3⅛ x 4 inches (⅛-inch larger bore than the Cadillac 16), giving a displacement of 490.8 cubic inches. It develops 200 horsepower at 3400 revolutions per minute. Aluminum alloy is used wherever possible in

order to reduce weight. The following figures will vouch for this accomplishment: 1 horsepower is developed for each 2.454 cubic inch; there is 1 horsepower for each 4.65 pounds of engine weight and 1 horsepower for each 24 pounds of car weight.

A 45 degree angle is used between the cylinder banks. They and the upper half of the crankcase are cast together, as pictured in Fig. 1. The cylinder wall is in the form of a case hardened steel liner, Fig. 2, which is sealed at the top by the head gasket and at the bottom by two rubber rings at the base of the water jacket. Heat from the engine practically vulcanizes them to the liner and a water-tight joint results. The removable liner has been used in truck and tractor engines. Its virtue is uniform cooling from the surrounding water and ease of replacement in the event of scoring. Heretofore the liner has been made of gray iron and Marmon's use of case hardened steel marks a new development. It is claimed that wear is practically imperceptible.

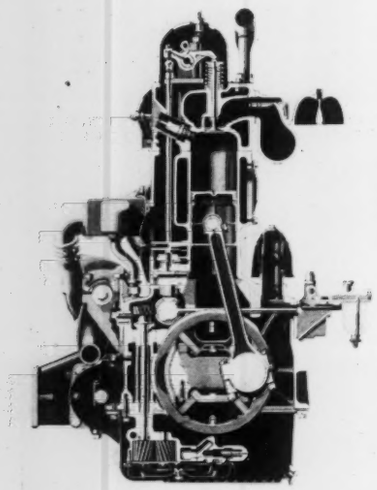


Fig. 3—Buick engine transverse section showing helical gear oil pump, oil-water intercooler, vibration damping device, etc.

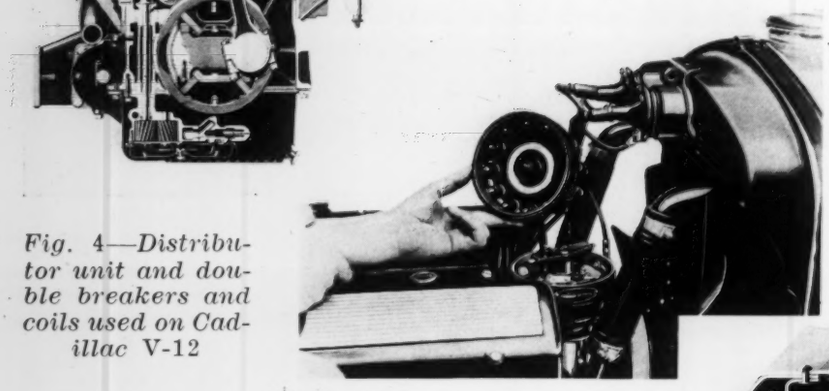


Fig. 4—Distributor unit and double breakers and coils used on Cadillac V-12

While only being used in experimental engines, a new alloy, "Ni-resist," has been developed which is ideally suited for liner use. It has a coefficient of expansion half again as great as ordinary gray iron and has a nickel content of about 14 per cent. It also is rust resistant. It makes an ideal combination with pistons of aluminum alloy having a high silicon content, their coefficients of expansion being very nearly alike.

Another interesting engine is the Cadillac 12. It follows the same general design of the V-16 that was described in the February 1930 issue of MACHINE DESIGN. However it has ⅛-inch more bore. The 45 degree angle between the cylinder banks is maintained and while this does not give equal firing spacing, the number of power impulses per revolution is sufficient to prevent any perceptible torque fluctuation. Some designers prefer this out-of-step condition to perfect synchronization as one means of reducing torsional vibration of the crankshaft. Lincoln always has maintained a 60 degree angle on its V-8, whereas 90 degrees would give equal spacing.

The intake silencer is connected to the carburetor and is one of the noteworthy accomplishments of the year. Due to the wide use of eight or more cylinder engines, the intensity of air vibration in the intake manifold has increased, resulting in a discomforting "power roar." Most cars are equipped with silencers of the resonator type, in which neutralization of the sound waves is attempted to prevent the vibration of the air column from extending to the outside.

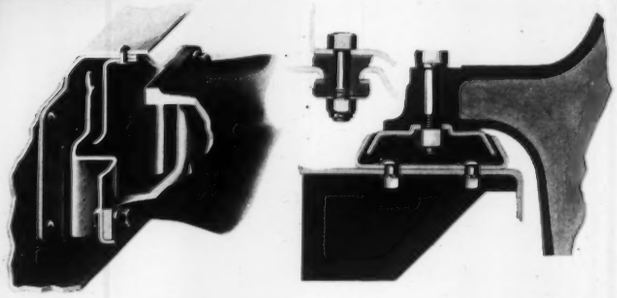


Fig. 5—(Below)—Transmission of vibration to the frame is prevented by rubber mountings of the type shown. The mountings now used necessitate employment of a copper ribbon connection between engine and frame to complete the ground circuit

Other engine quieting measures are the reduction of fan, oil pump and exhaust pipe noises. There have been changes in the shape and pitch of the fan blades, the use of six blades instead of four, and this sometimes in combination with a reduction in fan diameter or speed. To silence the action of the oil pump, helical gears are being used in place of the straight spur tooth. The sectioned engine in Fig. 3 is the Buick and the oil pump will be seen at the left of the sump. To deaden the metallic "ping" heard in the exhaust pipe, it sometimes is wrapped with asbestos insulation. This also protects the carburetor from undue heat.

Cooling of the lubricating oil is essential in view of sustained high engine speeds. An oil-water intercooler is used by Buick and will be

seen in Fig. 3, above the water pump. The latter discharges cooling water into the housing, which passes through the tubes of a small radiator and thence to the cylinder water jacket. The discharge of the oil pump flows around the tubes on its way to the bearings. A safety by-pass valve is provided, short-circuiting the cooler should the viscosity of the oil be too high. On the Hupmobile, a short section of the radiator core is partitioned off for the circulation of the oil. The engine is provided with a double oil pump, one maintaining circulation through the radiator and the other maintaining circulation within the engine. A by-pass valve also is provided.

Use of Vibration Dampers Increases

A ring type of vibration damper is used by Buick and, as will be seen in Fig. 3, this has four sets of radially disposed, laminated springs. It is machined, assembled and balanced entirely separately from the crankshaft, to which it later is attached on the cheek between No. 1 and No. 2 cylinders. An increasingly popular type of damper consists of a rubber plate bonded to a pair of disks, one being attached to a hub on the front end of the crankshaft and the other to the heavily weighted fan pulley which is piloted loosely on the hub.

High rotative speeds and the large number of cylinders impose new demands on the ignition system. With eight or more cylinders, two breakers and coils are used. The breakers are adjusted carefully for relative timing. Fig. 4 shows the Cadillac 12 distributor unit and coils. The latter are mounted in the radiator top-tank. This cleans up the engine compartment and also provides more nearly constant coil temperature. The coils are connected to the double-arm rotor by means of a button and ring contact. In this way the terminals from all the plugs are radially disposed in the distributor cap.

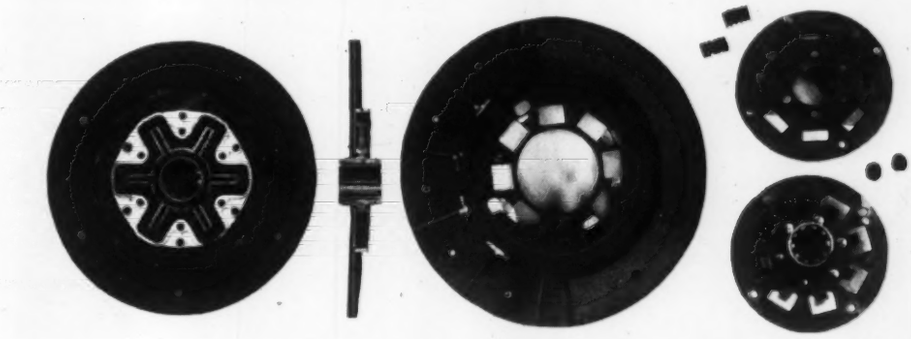
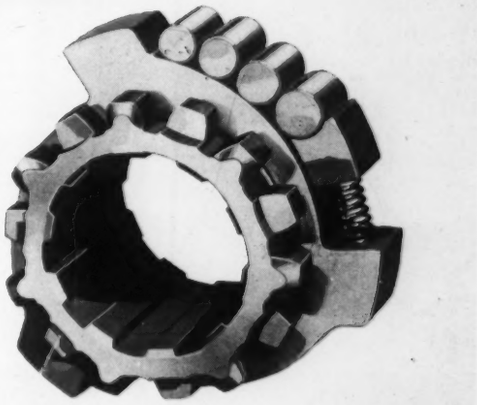


Fig. 7—(Left)—Cushion drives are incorporated in many clutches to dampen out torque impulses. Fig. 8—(Below) — Three-section inner member of free wheel used by Hupmobile



Rubber mountings are used on most engines to prevent the transmission of vibration to the frame. Some of these are shown in Fig. 5. Where the bell-housing formerly acted as a frame cross-member, the flexibility of the rubber mountings calls for an additional cross-member at this point to preserve the frame rigidity. These mountings also require a copper-ribbon connection between the engine and frame to complete the engine ground circuit.

To dampen out whatever torque impulses might be transmitted from the engine, most clutches have a cushion-drive incorporated in them. Two new types have been developed by Borg and Beck and are shown in Fig. 7. In the rubber drive, the six-spoke hub is surrounded by a uniform thickness of rubber which is contained within a housing riveted to the clutch disc. In the spring drive, no pins are used adjacent to the springs but the latter are nested in rectangular openings in the clutch disk shown in the lower part of the illustration and openings of equal length in adjacent hub plates.

Since the announcement of the Studebaker

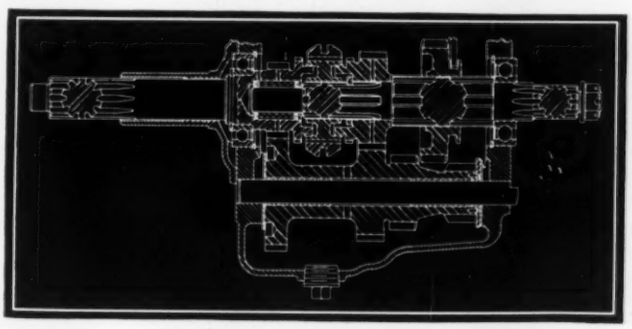


Fig. 6—Simple form of poppet control as used in new Auburn transmission

free-wheeling transmission in the September, 1930, issue, Lincoln and Hupmobile also have adopted it. One set of the rollers, together with the three-section eccentric inner member of the Hupmobile construction, is seen in Fig. 8. Lincoln uses eight rollers instead of the twelve

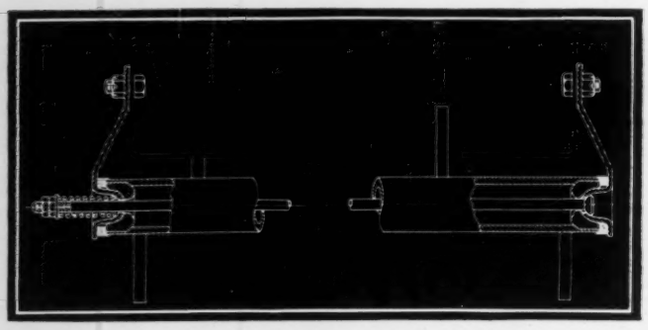


Fig. 9—Olds tubular brake cross-shaft, with spherical mountings and self-lubricating sockets

of Studebaker and Hupmobile. Auburn is using the "coaster control unit," which is synonymous with free-wheeling. A small lever directly in front of the driver's seat engages or disengages the device, which was described as the L. G. S. clutch drive in the same issue.

The internal gear transmission is losing adherents to the helical gear type, of which the Nash is a typical example. It will be recalled that the Studebaker unit also used helical gears. Packard is using all spur gears but includes the Nash type clutch for engaging "high" or the third speed constant-mesh gears (Packard has a four-speed transmission). Hudson has a conventional three-speed sliding gear transmission but uses different pitches on the constant mesh and second speed gears. It will be recalled that Reo with their herringbone gears originated this method of breaking up possible synchronism and thus reduce noise.

Transmission Units Are Changing

The synchro-mesh transmission, originated by Cadillac, now has been extended to Olds, Buick and Auburn. It has been simplified greatly by the elimination of the Cadillac hydraulic dash-pot timing control for the synchronizing clutches. A novelty consists in locating the second speed gears at the rear of the case. "High" or second speed is picked up by the sliding member on the main shaft. On the outside of this member is mounted the large sliding gear for first speed or reverse. The splines or teeth it slides upon are continued to each end of the sliding member and serve to pick up either end gear. The synchronizer unit, which also forms the female member of the cone clutch, has three straight spring-wire members. Movement of the sliding member presses the female clutch into engagement with the adjacent gear, equalizing their speeds, due to pressure against the springs. Further pressure bows the springs, releases the pressure of the clutch members, and the gear is positively engaged.

The Buick transmission works on the same general principle, excepting that the female cones are on an outside sleeve within which traverses the sliding member. The latter engages by means of spring-pressed poppets an internal groove in the former. The poppets provide the momentary drag of the clutch member as do the springs of the Olds unit.

A very simple form of poppet control is made by the Detroit Gear and Machine Co. shown in Fig. 6, and is used by Auburn. Whereas the previous synchro-mesh clutches have had a bronze ring acting as the female clutch member to prevent binding due to expansion from heat, the Detroit clutch member is of simple construction and integral with the centrally mounted poppet unit. The male cone members on the gears are grooved to allow the oil entrapped between the two parts of the clutch to be squeezed out rapidly to destroy the lubricating film that otherwise would delay the engagement. The outside clutching member pilots over the poppet member. Movement of the former drags the latter with it due to the poppet engagement. Further movement "drops" the poppets by pressing them inwardly and positive

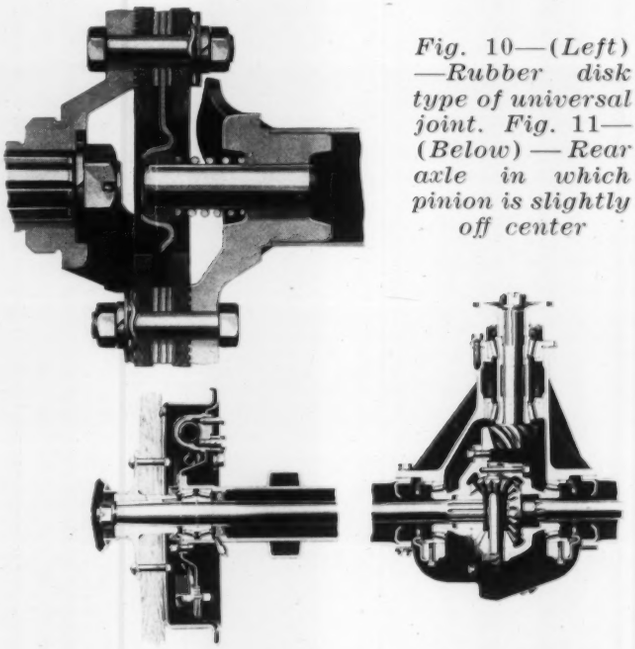


Fig. 10—(Left) —Rubber disk type of universal joint. Fig. 11—(Below) —Rear axle in which pinion is slightly off center

gear engagement ensues.

The spherical cap type of universal joint has been improved for better sealing of the lubricant within by the addition of a light, pressed-steel ring between the yoke and the spherical cap, being centered on the former. A rubber disk type of joint has been developed by Olds

and, as will be noted in Fig. 10, the centering device consists of a self-lubricating, spherical member, piloted on the right side nesting in a stamped socket supported by the left yoke.

For greater seat width, a number of cars are using 60-inch tread on the rear axle. Auburn uses 61-inch. Only a few years ago the 56-inch standard prevailed. For greater quietness, some cars have a finer pitch in the pinions and ring gears. Gearing is being made larger in

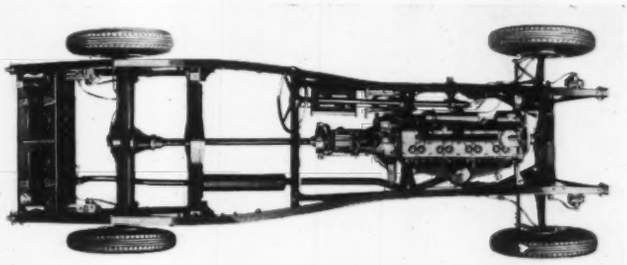


Fig. 12—Chassis construction employing a channel reinforcement in front of side rail

order to reduce tooth pressures in view of the increasing engine output. About a year ago, lead-soap lubricants were resorted to in order to cope with high tooth pressures. The resultant wear on the bearings was excessive, hence the revised design and the return to straight petroleum lubricants. The Chrysler eight rear axle is displayed in Fig. 11. The pinion is slightly off center in order to bring the ring gear more centrally between the differential bearings and thus divide the load more nearly equally between. The slight propeller shaft angularity entailed is negligible.

A torque tube construction is used by Chevrolet which requires that the spring seats swivel on the axle tube. Formerly the radius of the spring clips was on the axle center. To avoid distortion of the axle tube and a cramped bearing thereon, the new construction is employed. The clips are mounted transversely and pulling them up can do no harm.

Various means are used to increase the rigidity of the frame and thereby the body. The Chrysler construction in Fig. 12 uses a channel reinforcement in the front of the side rail which extends back to the cross member behind the transmission. The rear and central portions of the frame follow the contour of the body which is fastened directly to the side rails without the use of body sills or brackets. Demonstrating the possibilities of pressed steel as well as multipurpose design, the front cross member of the Chevrolet frame makes an interesting study. It primarily is a cross member but serves as well as an engine, radiator, starting crank and engine pan support. Its depth and width impart rigidity to the side rails. An "X" member with a spread of 75 inches is used by Auburn in the central portion of the frame. The propeller shaft passes through the center. Due to its shape, it braces forwardly to a further extent than could a transverse cross member.

Tubular Shafts Employed for Brakes

Mechanical brakes require robust parts that will not distort under pressure, otherwise the pedal or hand lever movement is partially lost. Hence levers, brackets, cross and camshafts must be rugged. Tubular cross-shafts of relatively large diameter are being used in place of solid shafts due to their superior torsional rigidity. The Olds cross-shaft in Fig. 9 is of interest because of its mounting and assembly. A pressed steel bracket with a spherical-portion hub supports the shaft at each side from the frame through the intermediary of a socket of self-lubricating material, much in the manner of the centering device of the universal joint previously described. A dust-seal at each side prevents entrance of dirt or water. The center rod, with constant spring tension on the various members, allows rapid assembly or disassembly while providing the "give" that is desirable with any universal mounting.

The latest development in chassis lubricating systems consists of a pump unit requiring no

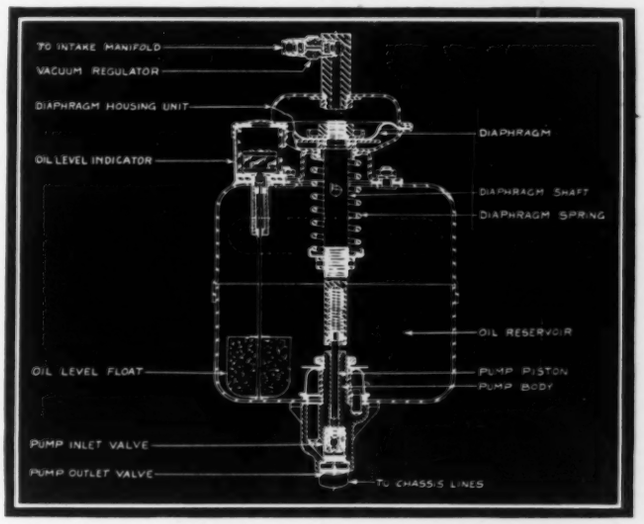


Fig. 13—Chassis pump actuated by diaphragm susceptible to variations in manifold vacuum

attention from the operator. The Bijur lubricator in Fig. 13 consists of a displacement pump actuated by a diaphragm that is susceptible to variations in the amount of vacuum in the intake manifold. The model shown has an oil level indicator which is not used when the reservoir is made of glass.

The steel stamping art has been developed to a high degree in body building. Whole sides are stamped out in one piece. Special welding methods involving enormous fixtures insure fabrication that was considered impossible only a few years ago.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

THE revolving table idea for carrying work to various stations for successive operations has been used in automatic machine tools, bottle blowing machines, bottle and carton filling machines, foundry equipment, etc. It is a cousin to the assembly line in automobile and mechanical refrigerator plants.

But of all its many applications, none is more interesting or more indicative of its versatility than that of the Rotolactor—a cow-milking machine employed on the farms of the Walker-Gordon Laboratories of the Borden Research Foundation at Plainsboro, N. J. The machine washes, dries and milks 50 cows every 12½ minutes. It consists of a circular revolving platform 60 feet in diameter, the outer ring of which is 8½ feet wide. This narrow platform, on which are mounted 50 stalls and stanchions, rotates slowly, around a circular chamber 44 feet in diameter.

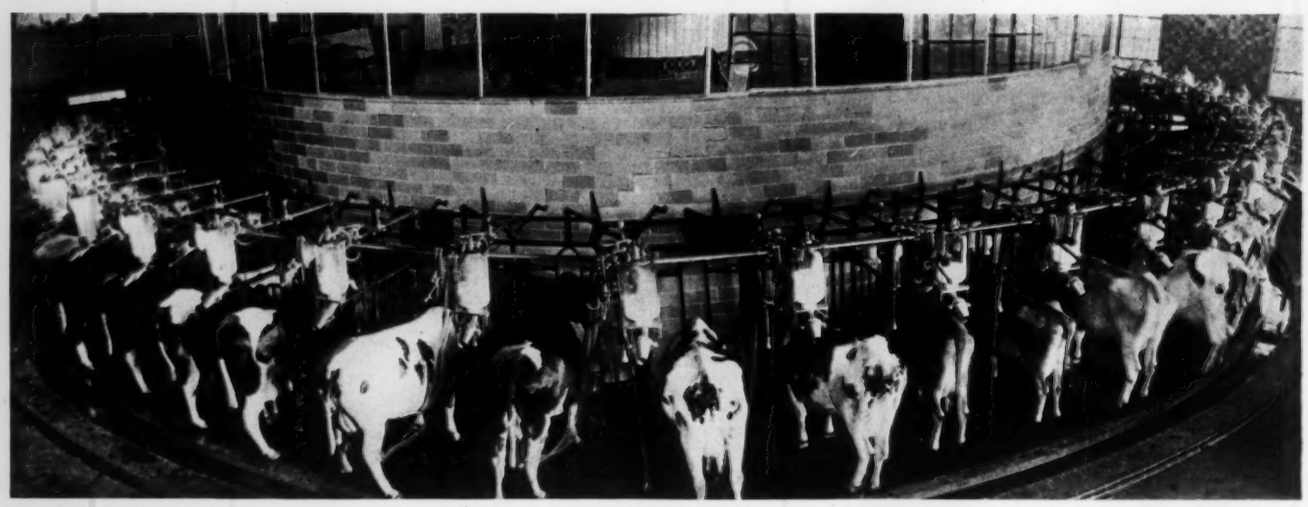
Continuous Operation Is Assured

The cows come into the Rotolactor through a covered runway. As each cow approaches the rotating platform, a vacant stall appears before her and she steps into it. A stanchion closes about her neck automatically and the platform takes her slowly to the left where she gets a shower bath. Then blasts of warm air dry the cow, an attendant wipes her udder with a fresh towel, another tests her milk, a third attaches the four teat cups and the actual milking process begins.

When 12½ minutes are up the cow is around to her starting place. The stanchion opens automatically, the cow steps out and is on her way to the barn. In the meantime the Rotolactor has dumped the milk into an automatic weighing and recording machine. The milk then flows through sterile pipes, is filtered and bottled with almost no contact with air. The machine has a capacity of 240 cows per hour.

The turntable, which weighs 60 tons is revolved at a rate of 15 feet a minute by a ¾-horsepower motor through 700 to 1 reduction gears operating on roller bearings. A few of the details of this interesting machine are shown in the accompanying illustrations.

The Rotolactor is not a complicated machine. Its design presented no unusual problems. But the use of the turntable idea in dairy practice is significant of the trend in agriculture toward mechanical devices. When Henry W. Jeffers, directing head of the Walker-Gordon laboratories and inventor of the Rotolactor, turned to machine design for a solution of his



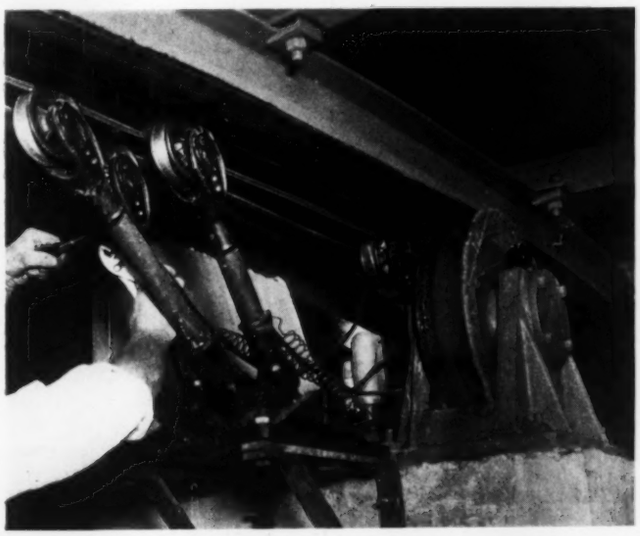
The Rotolactor—a revolving table with automatic devices for washing, drying and milking 50 cows in 12½ minutes. The turntable travels at a speed of 15 feet per minute

milking problem, he only did what many progressive agriculturists will be doing 10 years from now.

Machinery Beats Weather Hazard

MECHANIZATION of the farm has great possibilities, as is proved by another Walker-Gordon innovation, which is called a green feed dehydrating machine. Green alfalfa is cut in any weather and fed at once into this machine, which first cuts it up into short lengths and then dries it thoroughly by artificial heat. The drying part of the machine is similar to a cement kiln or to a rotating horizontal drum in which pulverized coal is dried. This is a simple application of industrial equipment, but think what it means to the farmer! He does not have to wait for a dry day to cut his hay or alfalfa. He runs no risk of mold or rot. His work schedule is not dependent on the weather, the machine keeping a haying crew busy every day during the growing season.

And still another Walker-Gordon development is a machine which compresses dehydrated, ground feed into cubes of convenient size—about ¾-inch on a side. The users of this machine predict that cubed feed eventually will be as common as baled hay. Think what this means in reduced shipping costs, cubed feed having much less bulk. Another advantage also is that it permits varying the number of cubes of different kinds of feeds so that rations can be made up to suit individual needs of each animal, thus eliminating the weighing and mixing of loose feeds.



Electric current for operating equipment on the table is taken from trolleys underneath

Builders of material handling machinery, drying kilns and briquetting presses might well look into the possibility of adapting their equipment to use on the farm. The time may come when mechanical devices of this kind will prove the salvation of American agriculture, just as reaping and threshing machinery saved it half a century ago.

The table is revolved by a ¾-horsepower motor through a DeLaval 700 to 1 reduction gear unit. Note adjusting bolts and cushioning springs

Launch Attacks on Noise

IN MANY of the issues of the past year, MACHINE DESIGN emphasized the increasing importance of elimination of unnecessary noise in machines. Current events now indicate that this emphasis was both timely and appropriate. At every turn in scientific and engineering circles one sees definite signs of an advancing attack upon needless noise.

For instance the New York automobile show, in progress as this is written, abounds with numerous devices calculated to minimize annoying noises. In some of the 1931 models the pitch of pinions and ring gears has been modified to promote quieter operation. Likewise exhaust pipes are being wrapped with sheet asbestos to eliminate the metallic "ping" which is heard from unwrapped tubes. Changes in cooling fans, oil and water pump drives, and other minor details have been made in an effort to reduce noise. Rubber mountings for the motor to minimize vibration also are gaining favor. These and other tendencies in design are discussed in detail by Mr. Wolf in the leading article in this issue.

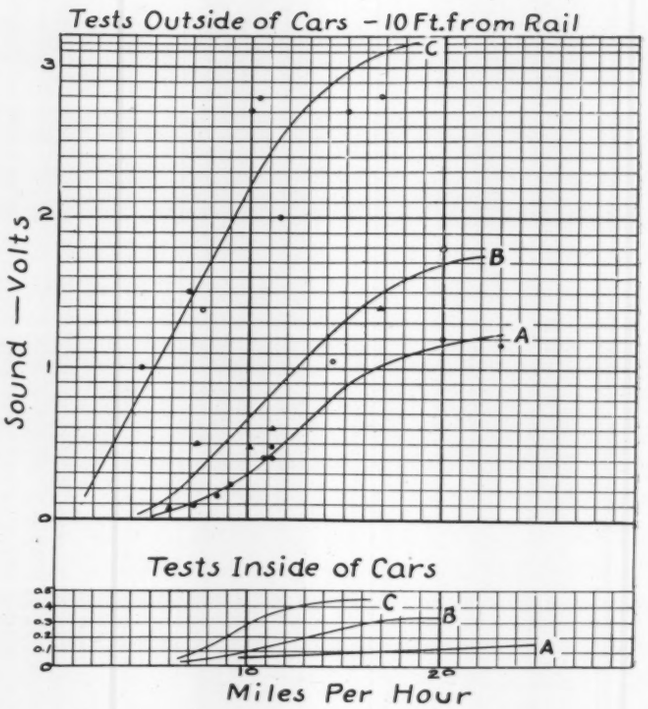
Elimination of noise figured prominently in the deliberations of the American Association for the Advancement of Science in Cleveland during the last week of December. Dr. William Braid White, director of acoustic research, American Steel & Wire Co., Chicago, attracted national attention by a discussion of the progress that is being made in the study of city noises. According to Dr. White, when one listens to the crashes, bangs and clatters of a city from a point 20 or more stories above the street level, these sounds merge into a continuous roar, under which may be heard a bass hum or "ground

tone." In New York this tone corresponds roughly to the hum of 60-cycle electric current, which stands between A and B flat in the low bass. In London the ground tone corresponds to low C, and in Chicago to E flat.

That these studies are not far removed from noises of machines is indicated by Dr. White's reports on typwriter noises. And from this line of investigation it is but a short step to the utilization of the sound moving picture apparatus for photographing machinery and simultaneously detecting accompanying noises.

Definite progress in these directions already has been made, and as the fund of knowledge increases, more and more pressure will be exerted upon machine designers to create noiseless machines.

The exhibition held in conjunction with the Cleveland meeting of scientists included a display of sound absorbing materials, some of which may find application in rooms where machinery is operated. The United States bureau of standards exhibited tiles of compressed excelsior, compressed rock wool, Masonite and acoustic Celotex and Sabonite acoustical plaster. The Bell Telephone laboratories demonstrated an automatic sound level recorder and a noise meter for recording graphs of speech.



Comparative Noise Tests on Streetcars
A—New railcoach (described in text)
B—Double truck car with aluminum body
C—Maximum traction (ordinary type)

New Ideas in Coach Design

WATCH for revolutionary improvements in railroad and street railway passenger coaches! The public is demanding greater comfort and the transportation interests are looking for increased economy in operation. Already the pressure of these influences is being felt by designers.

Several railroads, including the Baltimore & Ohio, are experimenting with air conditioning systems on dining cars. The equipment includes mechanical air filters of steel wool in sheet steel containers; refrigerating coils for cooling the filtered air; and motor driven fans for distributing the conditioned air. The design problem is simply that of providing the usual air conditioning apparatus—motors, compressors, filters, fans, etc.—in compact units which take up minimum space in a railway coach.

Early in December, John R. Blackhall, general manager, Chicago, North Shore & Milwaukee Railroad Co., Chicago described for members of the Western Society of Engineers a new type of street railway coach designed to meet the competition of buses and automobiles.

The car seats 40 passengers. Its exterior is finished in ribbed and polished Duco, comparable to the best automobile finishes. It is equipped with chromium plated bumpers, for utility and appearance. Its windows are plate glass instead of plain cylinder glass, and the sashless panes are raised or lowered by automotive crank mechanisms. Seats are equipped with springs and covered with leather. The coach is ventilated positively by a volume exhaust blower and heated electrically.

All of these details are designed for the passengers' comfort, but the coach also is distinctive in that it can be operated more economically than ordinary street cars. Up to 15 miles per hour the "pick-up" of this coach is greater than that of most automobiles. It has unusual braking power also.

Sound insulation was given unusual consideration. Wheel resonance was minimized by a device suggested by the R. D. Nuttall Co. The wheel was bored axially under the flange. An annular ring was turned with an outside diameter ⅛-inch smaller than the bore in the wheel. The ring was split and inserted in the wheel with 1/16-inch of Vellumoid packing between. The ring then was expanded and spot welded to the wheel at a few points. This expedient successfully reduced the resonant bell-like tone of the wheel to a minimum.

Rubber pads between chassis frame and springs, Masonite insulation on the floors, rubber bushings on the trolley base, rubber insulation on the supporting bolts of motors and other devices cut the avoidable noise to almost zero. The result, as measured in comparisons with other cars, is shown in the accompanying chart, which is reproduced from the December issue of the *Journal* of the Western Society of Engineers.

Here is clear evidence that the noise problem can be solved if it is given the attention it deserves.

Designing Elliptical Gearing by Simple Formulas

By F. B. Fuller

OF THE many types and varieties of motion in machinery, this discussion deals with rotary motion at varying speed, and particularly with that common variety where the demand is for a single maximum and a single minimum of velocity per revolution. In such a case the use of elliptical gearing is one of the simplest and, everything considered, one of the cheapest and most efficient methods available. By subsequent multiplication of speed, such gears also can be employed where more than one pair of maximum and minimum velocities is required, provided always that the time interval between each maximum and its preceding and succeeding minimum be the same, and that an approximately constant acceleration and deceleration between these velocities is satisfactory.

Fig. 1 is a familiar time-space chart for a driven elliptical gear. Time in degrees for one revolution is represented horizontally, but the distance represented vertically is angular distance—also in degrees. The straight diagonal line is the "curve" of an "elliptical" gear whose eccentricity is zero, and the dotted curved line is the curve of the theoretical gear whose eccentricity is nearly equal to half its long diameter. Both of these conditions are limiting cases; the former is a case of ordinary concentric spur gears (this line also may be used to represent the constant speed of the driving gear); the latter is a condition which must not be closely approached since, as the chart shows plainly, its maximum speed is almost infinite. The full line represents an average condition well within the limits of good practice, in this case a pair of elliptical gears with a 3 to 1 maximum-to-minimum speed ratio.

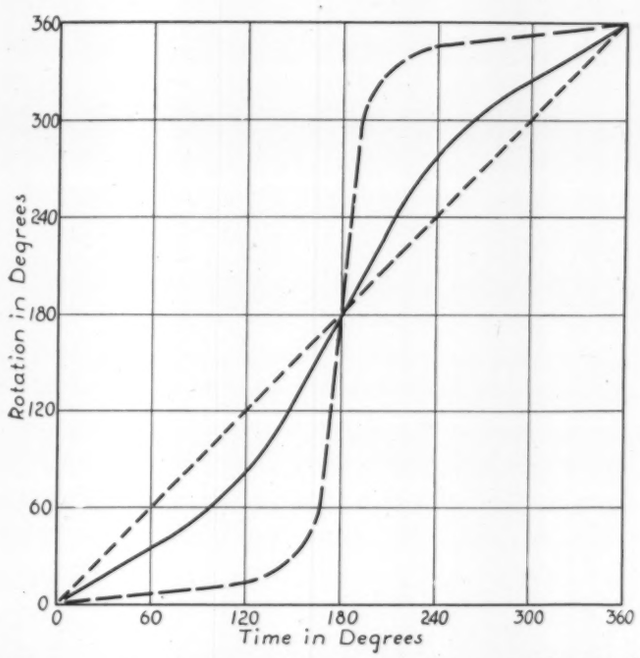


Fig. 1—Time-space chart for driven elliptical gear. Full line shows good practice

Standard Calculations Are Intricate

In most machines nothing but cut gears would be acceptable, and even where cast teeth can be used the gears have to be accurately calculated, and metal patterns with cut gear teeth have to be made. Probably these calculations, in the drafting room, constitute the most dreaded thing about elliptical gearing. The process, as set forth in most reference books on the subject, is intricate and often empirical, leading the designer through such a maze of rules that it is difficult for him to remember clearly what has been accomplished, and what is the next step to perform.

In this article no claim is made for new discoveries. Its object is the simplification and organization of facts that long have been known and used, and to that end is offered a set of progressive formulas for the calculation of the usual type of elliptical gears—where both gears of the pair have similar size and shape, where the shaft is eccentric, and where the speed ratio required is moderate (not exceeding, say, 5 to 1). There always are three known factors at the beginning of the problem. From these three given values the formulas build up, each from the values of those preceding it, new values that must be known before the gears can be made. All expressions are in their simplest form, and the formulas necessitate nothing more than a knowledge of the rudiments of algebra, such as required by the simpler formulas appearing

throughout all handbooks on mechanical subjects.

Theoretically, the pitch line of an elliptical gear should be a perfect ellipse, since any deviations from this would result in a certain amount of sliding, and in irregularities in the rates of acceleration and deceleration. But such a gear would be prohibitively expensive to cut, if indeed not impossible. The familiar method of drawing an ellipse by combining four arcs of circles results in a surprisingly close approximation when the eccentricity (i.e. the distance between the geometrical center and either of the foci) is comparatively small. Fig. 2 shows the exact contour of an elliptical gear which does not appear far from circular, the eccentricity being only 1/6 of its long diameter, yet it results in a ratio of 4 to 1 between the maximum and minimum speeds of the driven gear! This gear is made from four circular arcs, and the teeth consequently will be cut on four different centers. The approximation to a perfect running condition is all that ordinary practice would require, which, combined with its comparative simplicity in the machine shop, explains the almost universal adoption of the method of four-centers. This method is followed in the formulas to be given.

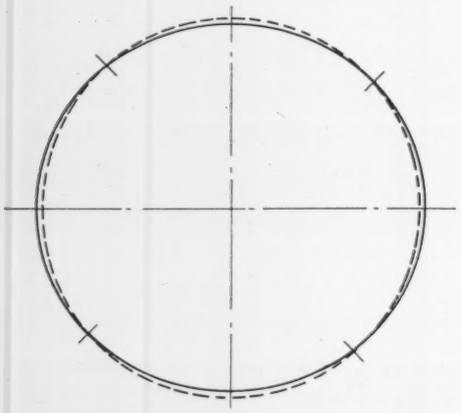


Fig. 2—Full line is "ellipse" composed of four circular arcs

Interference May Be Caused

But with ratios considerably greater than 4 to 1 the deviation becomes noticeable, and in extreme cases results in interference between the teeth of the two gears which can be removed only by filing them to fit in a suitable meshing fixture. If a high ratio of speeds must be used, it is preferable to employ a train of three elliptical gears, all alike in size and shape, but all calculated for a ratio ("R" in the formulas) equal to the square root of the ratio between the actual maximum and minimum velocities desired in the driven shaft. Their shaft centers should be all in one straight line.

Fig. 3 shows the gear, approximately as it will be dimensioned on the drawing, together with a list of those additional values which the machinist must know. The same letters are used on the drawing and table as are used in the formulas which follow. These formulas must be solved in the order of occurrence. The use of a table of six-or seven-place logarithms for those who have access to such will reduce considerably the time required, and is to be recommended. A slide rule is not sufficiently accurate for this work, though it makes a good check on the calculations.

Given C = Distance between shaft centers
Given P = Diametrical pitch, theoretical
Given R = Ratio of maximum to minimum speed of driven shaft

$$E = \frac{C(R-2\sqrt{R+1})}{2(R-1)}$$

$$S = \sqrt{C^2-4E^2}$$

$$D = \frac{C-S}{1.17144}$$

$$A = \frac{C}{2} - D$$

$$B = \frac{S}{2} + D$$

$$X = \frac{\pi A}{2}$$

$$Y = \frac{\pi B}{2}$$

$$Z = 2(X+Y)$$

$$F = P(A+B)$$

$T = F$, increased to next higher integer if F is fractional

$$Q = \frac{Z}{T}$$

$$V = \frac{X}{Q}$$

$$W = \frac{Y}{Q}$$

$$G = \frac{10}{V}$$

$$H = \frac{10}{W}$$

Expressed in such fractions as the dividing head has dials for.

These fractions must not deviate more than a minute amount from the true values of G and H or the last tooth cut on the gear will be intolerably thin or thick, the amount being T times the deviation.

There are a number of these values which need explanatory or advisory comments: The three values which are always known (or at least which may be decided at will) before elliptical gears are calculated, are

C, the desired center distance between driving and driven shafts. This will be the same as the long pitch diameter of the gears.

P, the desired pitch. The pitch as actually cut usually is a minute fraction smaller than the theoretically correct value, as will be found from working out a pair of gears.

R, the desired ratio of maximum velocity of driven gear to minimum velocity of driven gear. Here it is well to state that the ratio of minimum velocity to the driven gear to the velocity of the driving gear always is the re-

ciprocal of the ratio of the maximum velocity of the driven gear to the velocity of the driving gear, wherein elliptical gears differ fundamentally from other types of variable speed mechanisms which sometimes may be substituted for them, and which will be described in a later article in this magazine. For example, if the maximum velocity of the driven gear is 3/2 times that of the driver, then the minimum velocity will be 2/3 times that of the driver. But the ratio which R represents is that of *maximum to minimum*, that is, of 3/2 to 2/3, which always will be the square of the ratio between maximum velocity of the driven gear to the velocity of the driver, that is, $(3/2)^2$ or 9/4.

Finding Theoretical Number of Teeth

Before solving any of the formulas it is desirable to discover at once whether a satisfactory pair of gears will result from the three given values of C, P, and R, since a gear must have an integral number of teeth, and this results in the thickness of the teeth being, in nearly all cases, slightly less than standard, as figured from the given specifications. If this deviation from standard tooth thickness is great enough to cause undesirable backlash, there is no remedy but to change some one of these three given values. Therefore, before proceeding, it is well to determine the theoretical number of teeth in the gear (F) from the formula

$$F = \frac{CP\left[1+\sqrt{1-\left(\frac{\sqrt{R}-1}{\sqrt{R}+1}\right)^2}\right]}{2}$$

Additional Values for Cutting

C = Distance between shaft centers (Given)
P = Theoretical pitch (Given)
R = Ratio of maximum to minimum speed of driven shaft (Given)
Z = Periphery at pitch line
F = Theoretical number of teeth
T = Actual number of teeth cut
Q = Circular pitch of teeth as cut
V = Teeth in end quadrant
W = Teeth in side quadrant
G = Turns of dividing head per tooth in end quadrant
H = Turns of dividing head per tooth in side quadrant

Fig. 3—(Right)—Gear as dimensioned on drawing. Additional values are given above

An example will illustrate. Let $C = 6$; $P = 8$; $R = 4$.

$$\text{Then } F = \frac{48\left[1+\sqrt{1-(1/3)^2}\right]}{2} = 24\ (1+\sqrt{8/9}) =$$

$$24 + 16\sqrt{2} = 46.627 \text{ teeth}$$

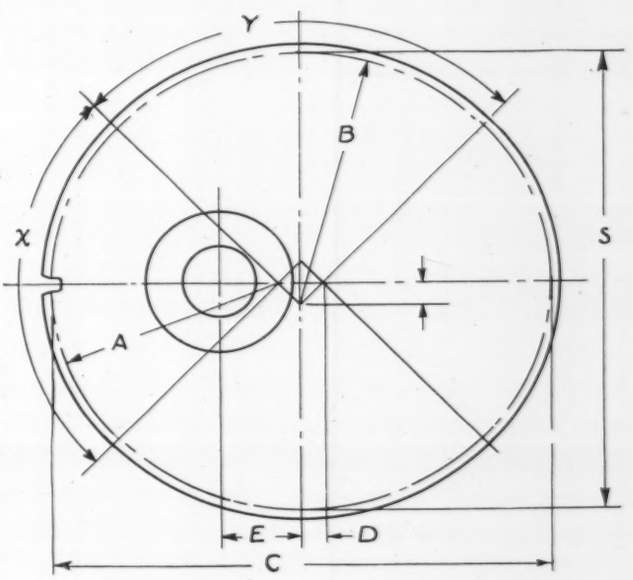
Since this must be increased to the next higher integer (higher, because if the next lower integer were used, all the teeth would be *thicker* than standard, and would not enter the tooth spaces as cut by standard cutter) we must make the actual number of teeth cut (T) equal to F + .373 or 47. This however makes the thickness of each tooth less than the standard ($\pi/2P$) by the amount.

$$\frac{\pi(T-F)}{PF} \text{ or } \frac{3.1416 \times .373}{8 \times 46.627} = .003$$

This difference may be too small to consider. But if it had been considered too great, or if T had been an even number and it was desired to make it odd (which feature will be discussed later) we should have to alter slightly the given value of either C or R. The easiest way would be to alter C, since T varies directly as C, and consequently we have merely to multiply the given value of C by T/F. In the foregoing example, multiplying 6 by 47/46.627 gives a new value of 6.048 for C which would render F equal to exactly 47. But if the original value of C cannot be changed we must slightly decrease the value of R, and this best can be done by trial since R is intricately involved in the formula for F as follows:

$$\frac{\sqrt{R}-1}{\sqrt{R}+1} = \frac{2}{CP}\sqrt{F\ (CP-F)}$$

Having made sure that the value of F will



turn out satisfactorily, we may proceed with the formulas.

E is the distance from the geometric center of the gear to the center of the hole, or shaft, (which latter must be at one of the geometric foci of the ellipse). In some cases E may originally be specified instead of R, and in that case R can be obtained from the formula

$$R = \left(\frac{C+2E}{C-2E}\right)^2$$

S is the short pitch diameter of the gear. Ac-

cording to the laws of ellipses it must be such that the distance from the shaft center to the point where the short diameter cuts the pitch line is one-half of the long pitch diameter.

D is the distance from the geometric center of the gear to each of the four centers on which the arbor is rotated while the teeth in the corresponding quadrant are being cut. (The constant 1.17144 is equal to $4 - 2\sqrt{2}$).

A is the pitch radius of the 2 end quadrants.

B is the pitch radius of the 2 side quadrants.

X is the length of the pitch line in the end quadrants.

Y is the length of the pitch line in the side quadrants.

Z is the entire pitch periphery.

F, which is the theoretical number of teeth in the gear, also might be calculated from $F = PZ/\pi$ but the form given is preferable.

T is the actual number of teeth as cut, and has already been discussed. It does, however, save a considerable amount of time in the machine shop, and sometimes in the drafting room, if *T* is an odd number. It is good practice, as

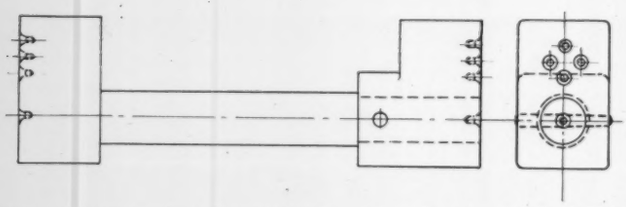


Fig. 4—Turning and milling fixture for elliptical gears

indicated in Fig. 3, to cut one tooth space at the peripheral points closest to the shaft, which will be exactly on the long diameter of the gear. When the pair of gears is in proper mesh, this space must receive a tooth of the mating gear cut on the opposite end of the long diameter, i.e. the point farthest from the shaft. It is easy to see that with an even number of teeth on each gear, one of the pair must have spaces wherever the other has teeth, and vice versa, which would necessitate setting up the two gears differently in the cutting process. But if each gear has an odd number of teeth, the same setup is correct for both, and usually both can be cut at the same time.

Q is the circular pitch as actually cut. Observe that the *standard* circular pitch is always π/P.

V is the number of teeth in each end quadrant, as cut, and

W is the corresponding number in each side quadrant. These values usually are fractional, but must be specified so that the machinist will know what fraction of a turn to give his dividing head at the end of a quadrant before changing to the new center for the next quadrant. *V* and *W* should be checked by the fact that $2(V + W) = T$.

G is the turns per tooth in each end quadrant.

H is the turns per tooth in each side quadrant. This refers to the turns of the dividing head on the milling machine, and presupposes the use of a standard 40-turn dividing head. (In case the now-obsolete 60 turn head be used, *G* will become $15/V$ and *H* will become $15/W$). These values must be expressed in such fractions as the dividing head has dials for, and the fractions must not deviate more than a minute amount from the true values of *G* and *H*, or the last tooth cut on the gear will be intolerably thin or thick. The subject of indexing is covered in most handbooks and need not be discussed here.

Since the purpose of the formulas is to relieve the designer of the necessity of going into the theory of elliptical gears, it is hoped that the above explanations will not appear impedimental. They are intended merely to aid in avoiding such errors as sometimes result from following rules blindly. The calculations usually will require less time than reading this article.

A special turning and milling fixture must be made for elliptical gearing. The one outlined in Fig. 4 will be found satisfactory. It consists of an arbor slightly tapered, to fit the hole in the gear, and a head at each end of it embodying the four centers. One of these heads is removable, and held in place by a taper pin. There is a fifth center in each head, concentric with the arbor, on which the hub of the gear may be turned.

The periphery of the gear along the side quadrants can be turned in a lathe, but along the end quadrants it must be milled.

It usually is a convenience to cast or rough-out a pair of elliptical gears in one piece, with their hubs toward each other. The periphery can be turned and milled, and if they have an odd number of teeth, the teeth can be cut in both gears at once, and the two parted afterward.

Provides Uniform Conductivity

FOR stresses of 2000 or more pounds per square inch in bolts, the electrical resistance between nuts and bolts is small and that of the Dardelet self-locking thread is much smaller than that of the American National coarse thread, results of recent research conducted by the bureau of standards revealed. It is interesting to note in the conclusions of the report of tests that for bolts of the same size and material under equal stresses in the bolt, the electrical contact resistance between the nut and bolt of the American national coarse thread is more than four times the corresponding resistance of the Dardelet thread.

Complete details of bureau of standard's work in this connection may be obtained from research paper No. 227, available from the Dardelet Threadlock Corp., 120 Broadway, New York.

Obviating Mechanical Troubles by Balancing of Parts

By Werner I. Senger

AS THE speed of machinery has increased, vibrations of a destructive or objectionable nature have developed. Because the designer or engineer is indifferent to or lacks information about the balancing problem, this trouble is taken care of by means of notes, such as, "To be balanced" or "Balance statically and dynamically." Thus, the problem of balancing is forced upon the manufacturing division to be solved by them without assistance from the designer.

However, the designer should be vitally interested in balancing because it provides a means for eliminating many mechanical difficulties and for reducing manufacturing cost. Some of the mechanical troubles which may be obviated are:

1. Excessive bearing wear or failure when the load due to the unbalanced condition is added to the normal bearing load.

2. Breakage of parts due to overloading or synchronous vibration of machine members under the periodic action of the unbalanced part.

3. Excessive power loss in bearing friction with a corresponding increase in the amount of lubricant required.

4. Improper functioning of the machine. For example, unbalanced rolls in a paper making machine produce a streaked or wavy paper; and an unbalanced holding fixture used on a machine tool such as a lathe or grinding machine may make it impossible to do perfect turning, boring or grinding.

Effects Reduction in Machining

Besides eliminating mechanical difficulties, many machining operations may be eliminated by balancing rotating parts, and the cost of balancing often will be only a small part of the cost of the machining which can be eliminated.

Today the automotive crankshaft has only the bearing surfaces machined because a balanced crankshaft with rough cheeks is better and cheaper than an unbalanced machined-all-over crankshaft. High speed pulleys on grinding machines, sensitive drilling machines and the like are made better and cheaper by balancing without the work involved in machining all

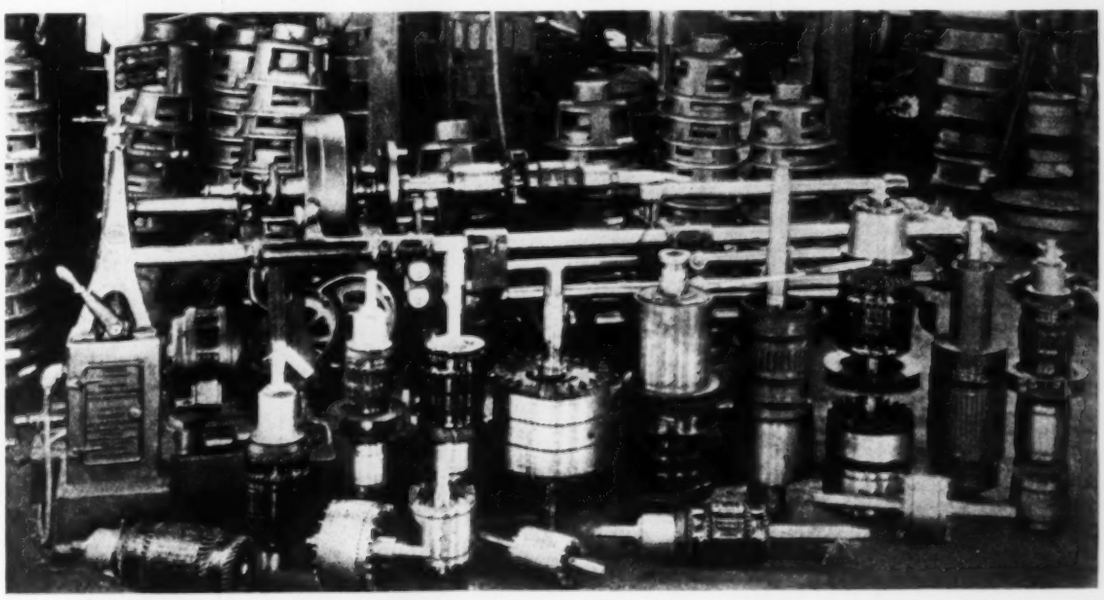


Fig. 1—Typical rotating parts around which balancing problems center

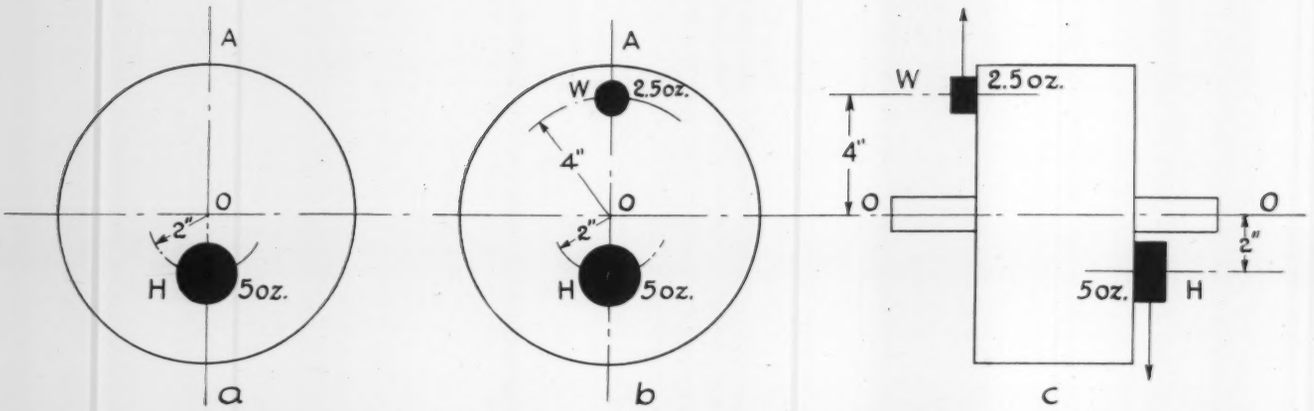


Fig. 2—a—Disk unbalanced by weight. b—Addition of another weight to correct balance. c—Cylinder in static balance but out of balance dynamically

over. Yet balancing will not eliminate all vibration and bearing trouble and, at the same time, give a machine at a lower manufacturing cost. Balancing machines measure the unbalanced centrifugal forces in rotating bodies which are rigid enough or supported in a sufficient number of bearings so as not to distort at operating speed. Some of the types of vibration which a balancing machine cannot eliminate are:

1. The vibration of a shaft at its "critical" or "whipping" speed. This whipping is due to the eccentricity of the center of mass of small transverse laminations of the shaft. These eccentric masses develop centrifugal forces which cause the shaft to deflect. When the frequency of this deflecting force is the same as the natural lateral frequency of the shaft whipping will occur.

2. The torsional vibrations of a rotating system such as a shaft carrying a disk on each end. In a system of this sort, the disks may oscillate in opposite directions, thus setting up a torsional vibration.

3. The vibration of machines due to the reciprocating motion of certain machine parts such as a piston or crosshead. Other parts such as links or connecting rods, whose motion is a resultant of a reciprocation and a rotation also may be included in this class of parts.

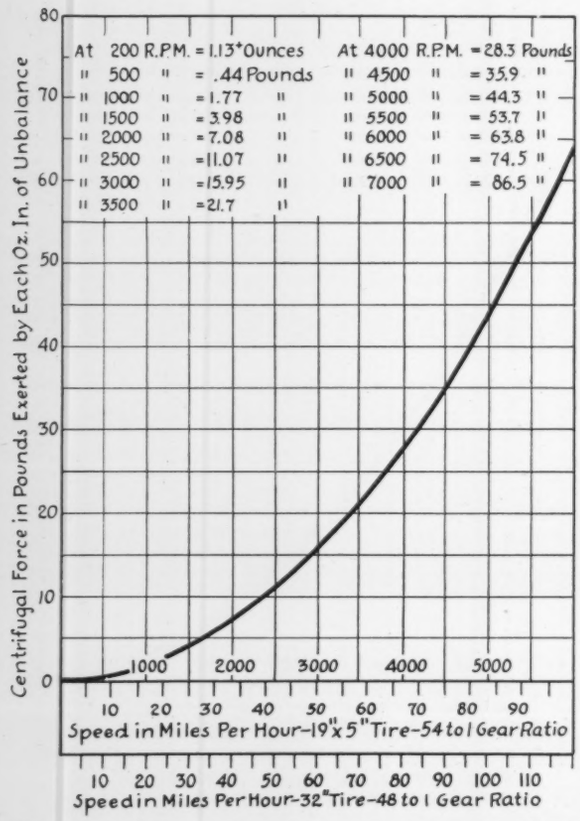


Fig. 3—Chart showing centrifugal force exerted by unbalance at various speeds

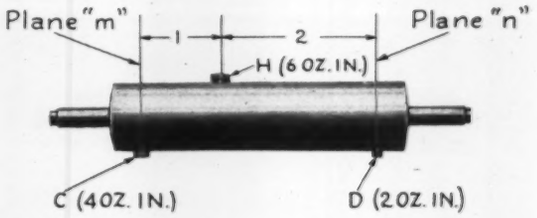


Fig. 4—Planes "m" and "n" should be chosen as far apart as possible

It is possible, by the use of balancing machines, to add or remove metal from a rotating body so that the body when rotated in its supports will not exert any variable disturbing action on the supports. This condition cannot be produced repeatably in the manufacturing process because the distribution of mass will not be uniform due to the nonhomogeneity of the material and due to errors in the geometrical dimensions of the part.

The importance of the correct balancing of rotating parts is especially great in high speed machinery. For example, at 3000 revolutions per minute, an unbalance equal to one ounce at a ten inch radius produces a disturbing force

of 159.5 pounds. This is represented graphically by the chart in Fig. 3, which shows the disturbing centrifugal force due to one ounce inch of unbalance. The ounce inch is the unit by which unbalance usually is measured and is the centrifugal force produced by a weight of one ounce at a distance of one inch from the axis of rotation.

Static and Dynamic Unbalance

This unit of unbalance is extremely useful in measuring and correcting for unbalance. Fig. 2*a* represents a disk which is unbalanced by a 5 ounce weight "H" fastened to its face 2 inches from the axis "O". Therefore, the disk is 5 times 2, or 10 ounce inches out of balance. This unbalance may be corrected by mounting on the face of the disk on the line "AO" any desired amount of weight at such a distance from center as to produce a counteracting unbalance of 10 ounce inches. Thus, in Fig. 2*b* a weight "W" of 2.5 ounces is placed 4 inches from axis "O" so as to exert a centrifugal force of 10 ounce inches directly opposite to the unbalance produced by "H". Therefore the disk, if of thin section and homogeneous, is in perfect balance.

Now, if the thickness of the disk be increased until it becomes a cylinder and if the correction weight "W" is applied diametrically opposite "H" but on the opposite face as shown in Fig. 2*c*, the cylinder would be in static balance but would vibrate when rotated. This part would be dynamically out of balance.

Dynamic balance can be secured only by correcting in two different planes perpendicular to the axis of rotation and preferably located near the ends of the object. Fig. 4 represents an object which requires dynamic balancing and "H" represents one of any number of possible heavy spots in the cylinder. The position of these heavy spots is unknown, and to balance the cylinder it is not necessary to find the exact location of the spots. However, two planes, "m" and "n" may be selected arbitrarily in which the weights "C" and "D" are placed to counteract the resultant effects of the heavy spots. The

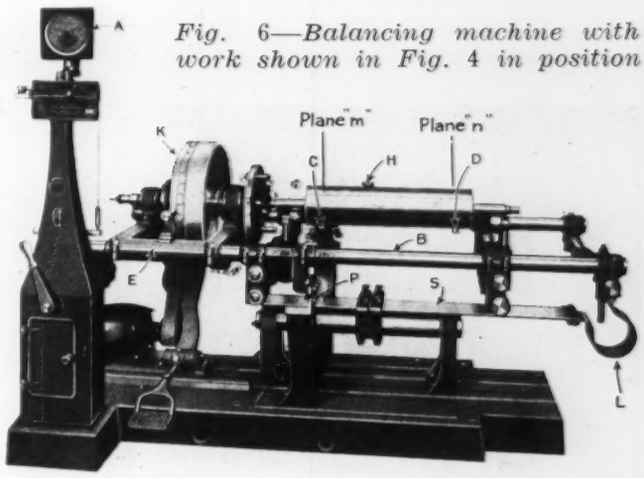


Fig. 6—Balancing machine with work shown in Fig. 4 in position

planes "m" and "n" may be chosen to suit the design of the work, but they should be as far removed from each other as the configuration of the work will permit; and remembering also that the greater the radius at which the correction is made, the smaller will be the amount of the correction.

In designing a part which is to be dynamically balanced, every effort should be made to provide these two planes of correction and to provide for a means of applying the corrections which will make possible the easy, quick and definite removal or addition of the exact weight of metal to give balance. A method of correction which is not easily and definitely made

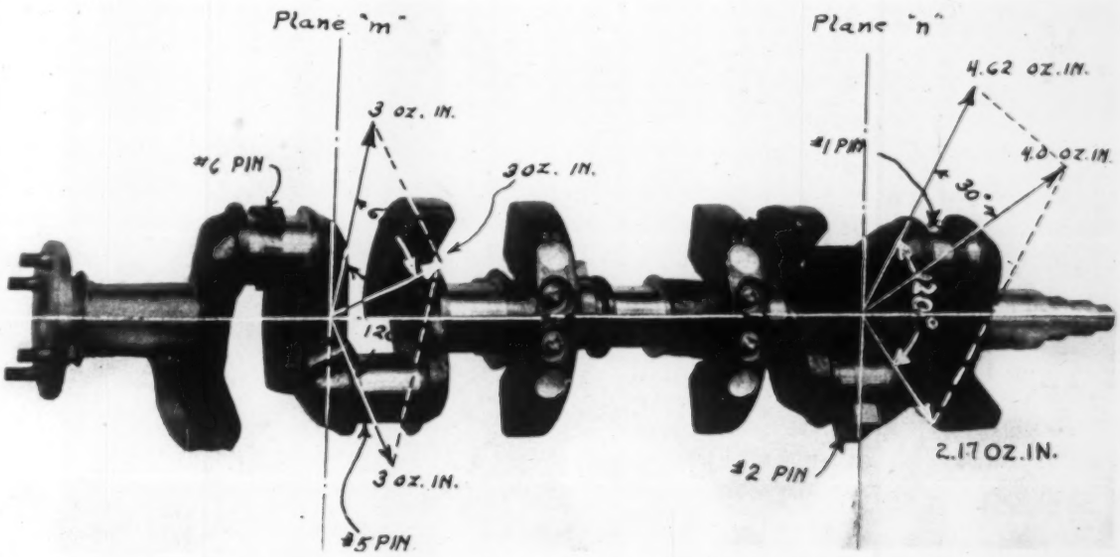


Fig. 5—In crankshafts such as this, the unbalance usually is controlled to be in certain crankpins to facilitate measurement and correction

fails to utilize the exact indications of the balancing machine. Drilling provides the most certain and easy method by which a desired weight of metal may be removed for correction, although milling, turning, shaping or grinding also may be used. The most practical way of adding metal for balance is by the use of

Fig. 7—Balancing machine arranged for checking and correcting pulleys

definite lengths of a given size of bar stock. However, metal also may be added by use of cast iron slugs, steel washers, or solder.

If the representative heavy spot "H" happens to be nearer the correction plane "m" than the correction plane "n", and is of the amount and in the position shown, then, in order to secure dynamic balance, the two weights "C" and "D" must be of different size. The sum of the two weights will, of course, equal the weight of "H", but the heavier one must be placed in the plane "m", shown in the illustration, and the lighter weight in the plane "n" farthest from "H". Corrections, of the amounts given and in the positions shown in Fig. 4, would put the cylinder into complete static and dynamic balance.

Provide for Correction at Large Radius

The designer's aim, then, in arranging a part for dynamic balancing is to provide two planes perpendicular to the axis of the shaft and removed one from the other as far as possible in which corrections may be made at as large a radius as possible by some easy, definite process. Often the shape of the work is such that in any transverse plane of correction, the radius at which corrections may be made is large enough only in certain rather limited sectors. This is the case in crankshafts, some types of fans and other irregularly shaped parts. In such parts it often is desirable to make component corrections, that is, in a given transverse plane to make two corrections of such magnitude as to make their effect the same as a correction made in line with the unbalance. Fig. 5 shows a crankshaft in which the unbalance in plane "m" is 3 ounce inches 60 degrees from number 6 pin and in plane "n" is 5 ounce inches, 30 degrees from number 1 pin. If the following component corrections are made, the crankshaft will balance:

In number 1 pin—4.62 ounce inches
In number 2 pin—2.17 ounce inches
In number 5 pin—3.00 ounce inches
In number 6 pin—3.00 ounce inches.

In an irregularly shaped piece such as this crankshaft, it often is convenient purposely to "throw" or control the unbalance within certain angles where correction may be made with the greatest convenience. For example, in the crankshaft, Fig. 5, the unbalance ordinarily is controlled to be in crankpins 1, 2, 5 and 6 so as to facilitate the measuring and correcting of the unbalance.

Part Carried on Rollers in Frame

Fig. 6 shows a representative type of dynamic balancing machine arranged for balancing the cylinder shown in Fig. 4. In this cylinder "H" again represents one of any number of possible heavy spots in the cylinder for which correction is to be made in planes "m" and "n". This particular machine, made by the Gisholt Machine Co., Madison, Wis., is arranged so as to carry the part to be balanced on two adjustable pairs of rollers which are carried on the frame "B". This frame, which also carries the headstock "E", is mounted on pivots "P" so that the frame, with its pivots, resembles the familiar type of scale beam used in "even balance" scales. Through the link "L", the frame is held flexibly in a horizontal position by means of the long flat spring "S". The movement of the frame "B" is indicated on the amplimeter "A".

By means of a positive flexible connection, the part to be balanced is connected to the headstock "E" which is in two parts so arranged

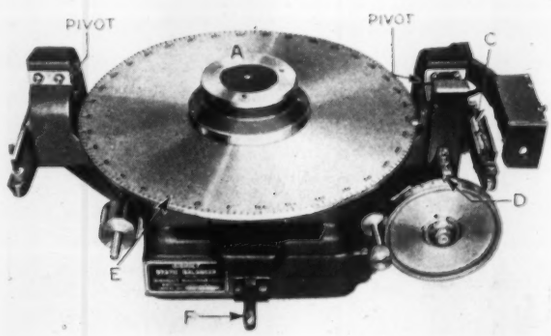


Fig. 8—Close-up of balancing unit. Heavy spots are indicated at C

that disk "K" can be turned angularly to any position with respect to the rest of the headstock and the part to be balanced. This disk "K" is provided with a sliding weight which may be clamped in any desired position along a

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Specify Proper Finish and Color for Your Product

By T. J. Maloney

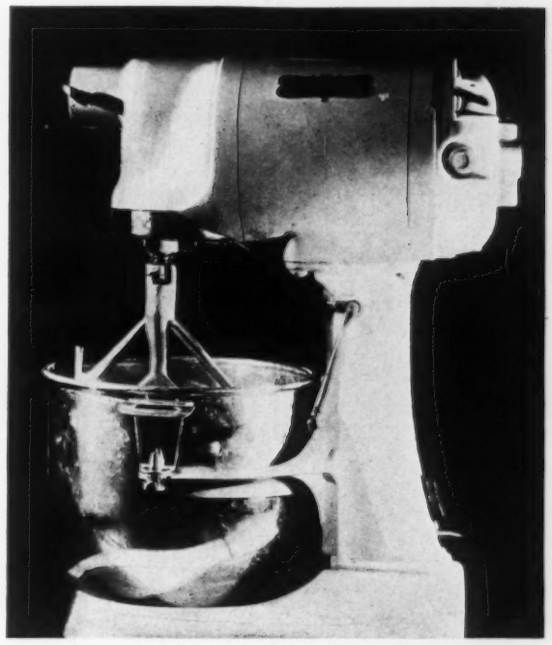


Fig. 1—Kitchen aid attractively finished in white for eye appeal and sanitary reasons

CORRECT design and production are fundamental to successful merchandizing; but forces, internal or external, that make a product readily merchandiseable through a good sales department change. A few years ago, advanced design and colorful finish almost were considered a drawback to salability—too much novelty. The staid and solid machine was what the consumer had learned to expect.

Perhaps the automotive industry receives undue emphasis as not only a production changer, but a design and style changer. Certain it is that body designers and finishers, when they finally found the medium-quick drying paint finishes they wanted, exploited this discovery to the utmost. They became leaders in the trend toward a well engineered, a beautifully designed, and artistically colored product.

Lacquers, quick drying enamels, and japans are the paint finishes most used, and the flexibility of these media is a boon to the designing engineer. Oven or air dry, spray, dip or brush, large or small storage facilities, and many other questions on the product, the finish, and the final appearance depend on the finish which coats the product, be it toy or truck.

Lacquer is obtainable in two forms. It may be had as a clear or pigmented product which sets up and hardens so quickly it must be applied with a spray gun. This is the type largely used throughout industry. The other form is a brushing lacquer, clear or pigmented, in which evaporation of the solvents is slower, and permits application with the brush. Their use has been greatly reduced by the introduction of four-hour enamels.

Quick drying enamels differ from lacquers through their varnish composition. The great drying speed induced by the new synthetic resins enables paint manufacturers to produce enamels which dry quickly on application. They can be applied with a spray gun, or can be brushed on satisfactorily.

The spray gun and dipping tank almost have entirely replaced the brush in product finishing. There are isolated cases of brushing and stippling being used to simulate wood graining on metal products. But even here, as in the case of producers of all metal office furniture, lithographing rolls print the paint on the table or cabinet, office partitions, etc., using equipment similar in principal to offset lithography in printing.

A great saving in time, and increased accuracy, resulted in another case where this same medium was used. A radio manufacturer was dipping condenser covers in a brown enamel, baking them, then masking the top and spraying the panels a lighter brown. The finishing superintendent chanced to see an auto license printing machine, placing the color on the numbers over the general tone of the background. He applied the same type of machine to lithographing the top panel a light

A SPECIALIST on finishes and finishing materials, the writer of the accompanying article is in an excellent position to speak authoritatively on this subject. He is associated with the New Jersey Zinc Co., New York, and recently carried out extensive surveys in numerous industrial plants.

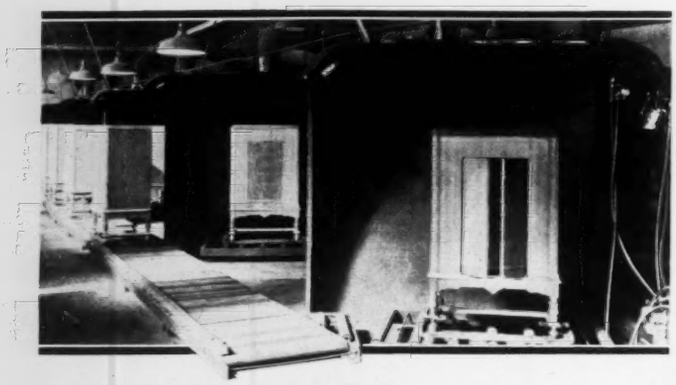


Fig. 2—Series of radio cabinets in position in the spray booths

brown, with considerable success. Masking was entirely discarded, the fuzzy edge sometimes apparent when spray and mask were used, disappeared and production was greatly increased while rejections vanished entirely.

A few points are almost self evident in choosing the finish, but will still bear repeating. First, the article itself. Is it machine tool, household electrical appliance, locomotive, trinket? What is its composition? Wood, metal, kind of metal, composition material, textile, etc? Is the surface a polished, rough, or grained structure? What will be its exposure, and how long should it last? How will it be prepared in order to receive the finish coating? How many coatings should it receive? What finish should be chosen and how will it be applied? And last, but not least, what color, colors or natural graining shall be used to enhance its appearance?

Dogmatic answers to these fundamentals are useless. But some of the effects achieved by outstanding firms, through studied design and decoration ought to be enlightening and helpful to the designing engineer, when he has to consider finishes as they effect the immediate production and ultimate saleability of his product.

Finish Gives One Piece Appearance

A milling machine manufacturer sums up a prevalent demand, and gives his answer to it. "Our customers always have expected machines in advance of those they have on their floors. Quality is taken for granted. But not in the old fashioned gadgety designs and somber colors, once so prevalent in the machine tool industry. The good machine tool must be dressed to look the part. The body of the milling machine you see is of gray iron, cast in three pieces. When it has received the fillers, ground coat, and numerous coatings of enamel necessary to give the high lusters specified, the entire finish has been built to such perfection that the body looks like a large and intricate one piece casting. We finish the majority in standard machine tool grey. But an increasing number of manufacturers are specifying their own colors, and they run from white to light gray, red, maroon, orange, blue and green."

The Simonds Saw Co. is to finish all its machinery in orange, in its new, novel windowless plant at Fitchburg, Mass. The visibility will be greater than with the former standard grey, the light reflection will be aided, and production and safety increase.

Spraying is a knack that all workmen cannot acquire, and though the ordinary run of it does not require high skill, it takes practice and a fair degree of proficiency to direct the gun. Wholly automatic spraying seldom is encountered, though condenser cans are finished thus in one large electrical equipment plant. The nozzle is fixed and the cans, in groups of eight, are placed on pinions on a movable disk. The pinions also are movable. As the can moves by the spray it also revolves, and is completely coated.

Dipping has definite advantages. In a large radio plant the finishing department superintendent is endeavoring to change his operations from 95 per cent spraying and 5 per cent dipping to 95 per cent dipping and 5 per cent spraying. His main problem in changing is not in finish, but in design. He must get ingenious holding devices which will allow a free flow of the enamel and eliminate dots, reflows and fatty edges.

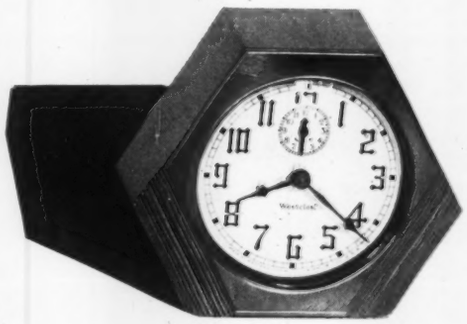


Fig. 3—Lacquer finish is employed on time-pieces for durability

The angle at which the parts are hung must be the one which offers every surety of a free run off. He does not rely on the dipping oven operator to place the piece at this angle. The hook or jig must be devised so the part can rest no other way.

On console panels, the peak under the old spray system was 5500 a day, using five men and five spray booths. After careful preliminary work designing the right setup for dipping, 5500 were produced in a day by one operator.

With even the greatest ingenuity in the design of holding devices, many parts cannot be dipped. There must be a fundamental simplicity—the part must help in its own solution. Redesign went further than jigs; it went to extreme simplicity of the parts themselves.

Container lids were sprayed at the rate of

600 a day. The number of rejects was tremendous. They changed to a dipping and baking—single dip and the customary 45 minutes at 260 degrees Fahr. in the drying ovens. To eliminate an air pocket which prevented a satisfactory coat on the interior, racks were devised to give the lids a preliminary plunge in the vertical position into the baking enamel. Production was increased to 1500 an hour, and no rejects.

Hand Work Still Is Employed

The largest cabinet section in the country is part of the plant of a radio and phonograph manufacturer. The continuous production system is used, and large quantities of a few standard models are turned out. But the workmanship still is essentially handicraft. When the completed cabinet reaches the finishing department it is carefully sanded by hand, sprayed, polished by hand, re-sprayed, repolished, and finally any slighted spots receive a final hand touching. The finish is a lacquer almost transparent, but tinted enough to accentuate the graining of the fine woods used.

A manufacturer using an alloy which responded to heat treatment to a marked degree was using an enamelling process to finish articles made from this alloy. His finishes in various colors were striking, and the articles met a ready market. Subject to considerable rough treatment, they did not stand up. Investigation proved that the baking heat on each of the two finish coats of enamel (1 hour at 200 degrees Fahr.) was enough to alter the structure of the alloy and cause the failure of the product. The finish was changed to an air drying lacquer, the heating eliminated, the troubles disappeared. Undoubtedly a so-called four-hour enamel would have accomplished the same results.

Two producers of machine tools conducted experiments along almost identical lines, with no knowledge of each other's efforts and results. The first painted all gray iron castings white before machining. The reason was purely psychological. With a cleaner casting, not only would the shop maintain a brighter appearance but, more important, planer and milling machine operators would do cleaner and more accurate work. The results were so satisfying that every casting going through the plant now is given a coat of white paint.

In the second shop, compressors are placed on the test block and run in before they receive their finish coating. The engineering staff decided to run comparative tests between the usual compressor and one painted a light color. This coating could be removed, or serve as a filler for later coats. On the cleaner, brighter compressor (though just as rough and unfinished otherwise) the testing was done with more accuracy, with no slip shod work on the setup.

These two instances are of little value as specific elements of design. But as means of accelerating the accuracy and workmanship of the completed machine, they are shop kinks of value.

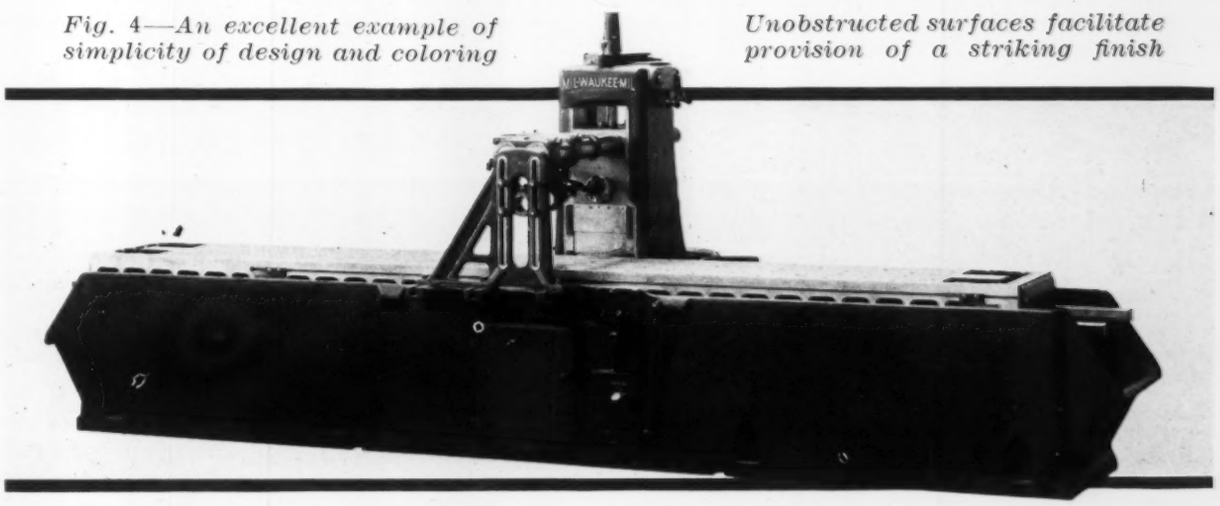
Color Choice Has No Set Rule

In so short an article, apologies are due for all acts of omission necessary. As the discussion has been brief almost to sketchiness, so must be the material devoted to color. Aside from the certain physical and mental reactions to certain colors, the elementary grouping and measurement, there is no set rule. One artist, an expert on color and color combinations as designed for automobile bodies, declares that only the tyro is certain in color. The expert, contrary to the facetious definition as "one who knows more and more about less and less" considers himself as one who knows "less and less about more and more," as he enters the labyrinth of color. There will be no effort expended here to go beyond the rudest rudiments.

Color has entered every field. It is seemingly a far cry from color to steel treating, yet one of this year's leading papers at the annual meeting of the American Society for Steel Treat-

Fig. 4—An excellent example of simplicity of design and coloring

Unobstructed surfaces facilitate provision of a striking finish



ing was delivered on color and color measurement by Kenneth Mees of the Eastman Kodak Co. Color is one of the chief things that aids in answering "yes" to the question of, "Will it Sell?"

Red is exciting; green is cooling; yellow is cheering; purple is subduing, blue is sobering. These are the emotional reactions generally accepted as the responses to the colors listed. And a recent survey shows that red (including tints of pink, or the darker shades of maroon) is the preference of approximately 42 per cent of women; purple next; while only 9 per cent prefer blue. Blue, however, is the preference of approximately 44 per cent of the men, red next, with 23 per cent, and purple third with 21 per cent.

These figures are interesting, but too much reliance cannot be placed on them in endeavoring to find the right color or combination to make any machine sell. A few controversial examples stress the importance of giving each problem a thorough study and actual testing

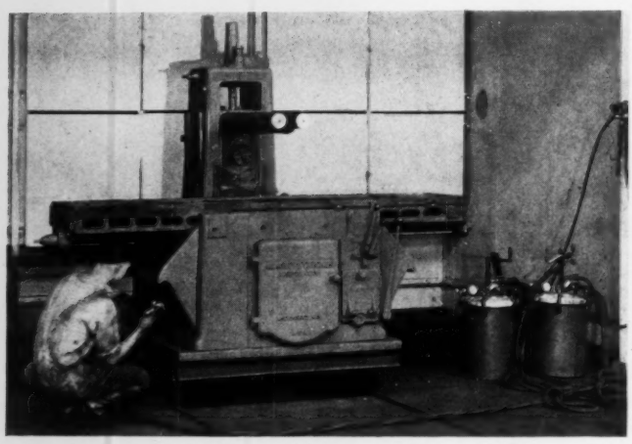


Fig. 5—Building up the base finish

before deciding on the color scheme.

A heating range manufacturer, when first presenting the type now so common, decided to finish stoves in colors intended to harmonize with the subdued tone of most American living rooms. They felt solid colors—maroons, deep browns, greens—preferable to imitation walnut, mahogany and oak. Anyway, what place had wood grain effects on a stove? The answer seems to be "none." But the stoves didn't sell. So wood grain finishes were resorted to, and the stoves sold, and most of those marketed are still finished in wood grain.

Color Has Seasonal Aspect

The seasonal aspect of color must be considered. The style aspect has its factor of domination. Witness the return to favor of black, as the most popular automobile body color this year, after an absence of a number of years. Perhaps the great popularity of chromium plated body trim was a deciding factor; certainly black is the complementary color for this silver-like finish.

The reasoning of the editor of one of the advertising trade papers regarding this switch to black is interesting—if several grains of salt are added to his suggestion of color in industry as a depression remedy. Commenting on the appearance of black and the current depression, he theorizes to the effect that a preponderence of manufacturers should lead their attack on sales and the gloom of depression by bringing back the gay colors of auto bodies of a few years ago. They would be significant of the confidence and gaiety with which industry sets about to restore prosperity. Perhaps so, but controversy wages weekly in the same publication as to whether the manufacturer should color his product to suit his taste and sell it to the public, or whether the public has certain trends of color consciousness which the manufacturer should regard.

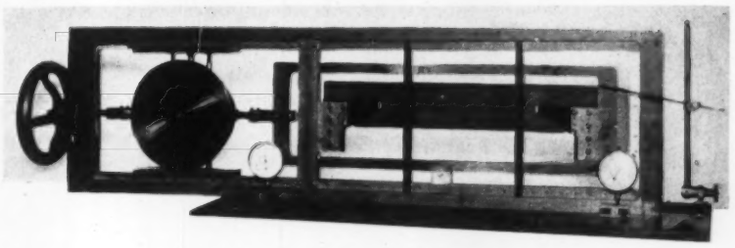
Intensive Consideration Is Necessary

These controversial items are introduced to show the study color necessitates. The wide interest taken in color by a recent survey undertaken by a leading publisher shows a large number of old products being dressed up with color.

But there are certainties—there is only one color for fire apparatus, from the chemical container to the huge hook and ladder truck. Red instinctively is so much the natural color, it becomes the standard. No manufacturer of an electrical refrigerator would think of red; but white, and light tints of green, creams and of course natural grain, are instinctively considered right. On machine tools Ford, Allis Chalmers, and many others believe a certain blue, deep enough to show no effect of dirt and oil, but bright enough to create a distinct color in a drab shop, is best. Many manufacturers paint dangerous parts red, regardless of the general color of the machine.

What are the surroundings in which the product is to be used? Do you want it to harmonize or contrast with these interiors? Do you know how color will help you achieve the effect of strength, or solidity, or height, or shortness of your design in the eye of the prospective customer?

When colors are chosen, it is important to determine the availability of these colors for production, and the kind of service the product will receive. Constant efforts to satisfy the demands of many customers in many lines have led to certainty of almost any color being furnished by leading lacquer and enamel manufacturers, on a production basis. But some wear better under exposure to sunlight than others. Salt water atmospheres may raise havoc. And of course, not only color, but the type of finish—lacquer, enamel, Japan, crinkle finish, straight spray finish, any one of the many popular novelty finishes—must be taken into consideration.



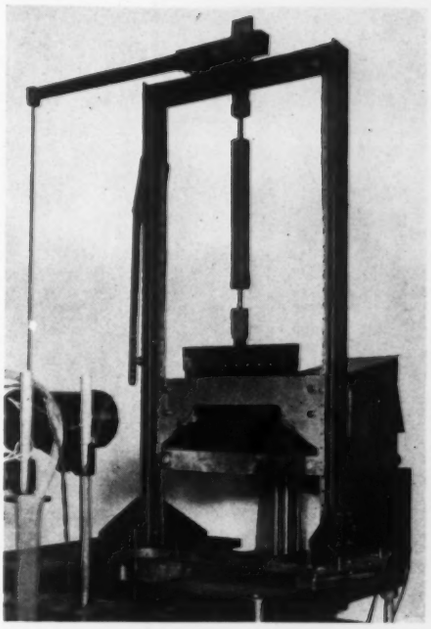


Fig. 1 (Above) and 3 (Right)—Arrangement for testing commutator bar for centrifugal force and assembly force, respectively

Photoelasticity—

and Its Application in Design

By R. V. Baud

SUPPLEMENTING the information given in the second article of this series, Mr. Baud's third and concluding contribution presents further data of interest to the design field on photoelastic analysis. The tests he discusses were carried out at the Westinghouse research laboratories, East Pittsburgh, Pa.

DETERMINATION of stresses by the photoelastic test method has been extended to many items and fields other than those referred to in the December issue of MACHINE DESIGN, in the second article of this series. Among these are the following items, each of which is treated in this contribution:

1. Rails.
2. Welds.
3. Fastenings: (a) turbine blades; (b) salient poles; (c) airplane propellers.
4. Turborotor elements: (a) coil retaining wedges; (b) teeth and endplates.
5. Commutators.

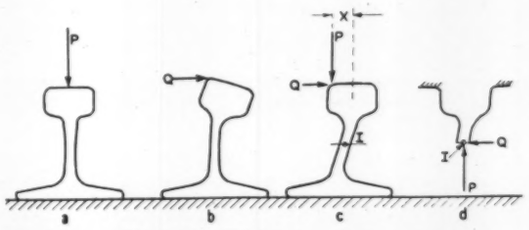


Fig. 2—Rail loads and deflections

The object of making a photoelastic study of rail stresses was twofold; namely, (1) to determine the cause of rail fractures that occurred in curves of railroads; (2) to obtain a better conception of the mechanics and enable selection of size of a rail on the basis of analytical consideration and experimental data. Similar procedure could be followed on photoelastic testing of stressed machine parts.

The most severe loading on the rail occurs in curves where a lateral force Q is introduced. There are two valid reasons to assume that in a curve the head is forced to move parallel to itself, Fig. 2-*c*:

1st. Due to a force Q alone an otherwise unrestrained rail deflects as shown in Fig. 2-*b*. This deflection induces a shift of the vertical load P from the center line, Fig. 2-*a*, to a line that has a distance x from the center line, Fig. 2-*c*.

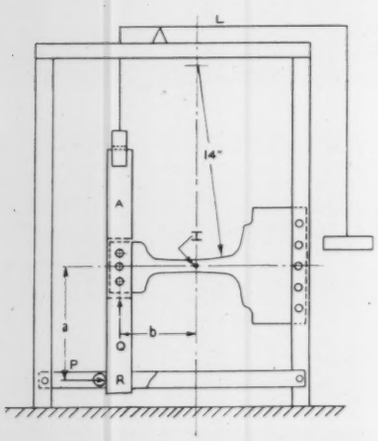
2nd. The adjacent material has a stiffening effect to prevent rotation of the head of the rail that is in contact.

This condition is simulated in a photoelastic experiment, Fig. 4. Dimensions of the model were those of a 130-pound rail. The lateral force Q was applied by a lever system. Load P

was applied at a distance a by a roller R to the bar A, which bar was attached rigidly to the head of the rail. The reason P was applied at a distance a instead of x was to reduce the friction force between roller and bar to a negligible quantity, thus permitting a simple and yet accurate determination of Q.

Point of Inflection Exists in Web

For such loading conditions there exists in the web a point of inflection denoted by I. A section perpendicular to the center line through I transmits only the lateral force Q and the compression load P=bQ/a*, but no bending moment. With this section determined the problem is simplified considerably. It then is customary to consider the problem as that of a "built-in" beam. In the case of the rail the web is considered the beam that is built into the head of the rail, Fig. 2-*d*. The standard beam formulas then are applied. This was done for section *S-S*, whereby the forces that were acting in the experiment were inserted into the beam



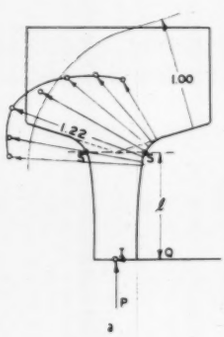
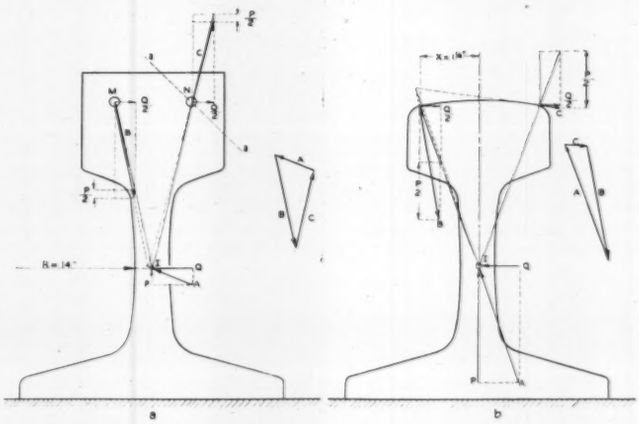


Fig. 4 (Left)—Testing apparatus for rails

formulas. Stresses so obtained are represented by the vectors marked 1.00 in Fig. 5.

By mere inspection of the image of the model it was found that the point I is located in the section through the centers of curvature of the web. Experimental stresses are as represented by the vectors in Fig. 5. Concentration factors, i. e., the ratios of maximum to computed stress, were found to be: Compression side, 1.32; tension side, 1.22.

The reason for the fact that the stresses in the compression fillet are larger than those at the tension side becomes obvious by examining the forces that were applied to the model, Fig. 6-*a*. It is seen that the force B is acting in the direction of the fillet that is in compression, producing additional compression stresses, whereas the force C acts against the material in the upper right hand corner; the tensile stresses due to the force C are small already for a section such as *a-a* and more so for the lower parts of the head. This is the reason the force C does not augment materially the stresses in the fillet that is subjected to tension. A difference in the magnitude of the stresses in the two fillets therefore is to be expected. This is true particularly for the case where the ratio P/Q is larger than that in the experiment, since in



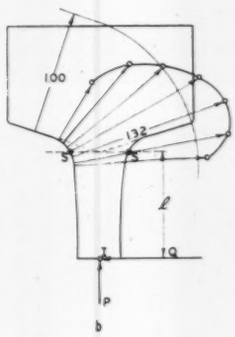


Fig. 6-a (Above)—Force diagram for model conditions. b—Force diagram for condition which may arise in actual case. Fig. 5 (Left)—Test results on rails

the latter the force P purposely was made small and the distance x large.

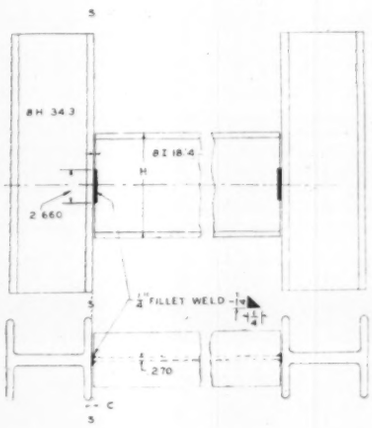
In Fig. 6-*b* the distance x is taken equal to 1¼ inches. It may represent fairly well the condition of a new rail and new tires. For rails and tires that have been in service for a considerable length of time, the wear that has occurred must be considered. By comparing Figs. 6-*b* with 6-*a* it is seen that in the actual case the discrepancy in the magnitudes of the stresses in the two fillets will be much larger than that observed in the experiment. This explains the failures mentioned that have been found in the compression fillet.

A difficulty encountered in computing rail stresses that yet remains to be overcome, is the determination of the section modulus of section *S-S* that should be considered in computing the bending stress for the actual rail. It may be necessary to resort to strain measurements on rails that are loaded as in service. For static loading, such measurement can be made readily along the web up to point S, as the curvature is small up to this point. The stress values so obtained multiplied with the concentration fac-

*This expresses the condition that there is no moment, i.e., no rotation of the head of the rail.

tors given in the foregoing represent the maximum stresses that occur in the fillets.

Additional strain measurements in point *S* are necessary in this case because the rail problem is a three-dimensional one and photoelastic tests alone cannot give the entire solution. However, insofar as the comparison of various rail sections with regard to stress is concerned, this can be done on the basis of photoelastic results alone.



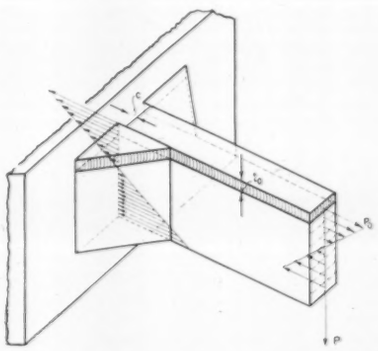


Fig. 7 (Left)—Connection of beams by fillet welds. Fig. 8 (Below)—Isometric view of weld

Such tests are in progress at present for three sections that are being considered, one of which is shown in Fig 6-*b*. These new tests include lateral loading as described in the foregoing, as well as central and eccentric vertical loading.

In the eccentric vertical load test it is necessary again to consider the effect of the adjacent material. This is done in the present tests by extending the head of the rail at the top and applying to the extension a restraining moment M_r of such magnitude as is believed representative for actual conditions.

The longitudinal stresses in the rail have not been mentioned so far. These stresses can be computed fairly accurately, however, and the results so obtained can best be verified by means of strain measurements on actual rails.

In combining structural elements by welds, intricate contours are obtained that are radically different from riveted or bolted constructions. The experience that the designer has gathered with such constructions therefore is not of much value in designing welded structures. Here opens a wide and fruitful field for photoelastic research.

Tests Performed on Welded Sections

Among the cases studied by the writer is that of an I beam connected to the flanges of two H beams by means of fillet welds, Fig. 7. The conditions were such that the H beams already were located and the I beam had to be placed later. This explains the clearances *C* which proved to be of considerable consequence for the strength of the weld, as is mentioned later.

A difficulty entering into this and similar weld problems is that the forces and stresses are not confined to any special plane. With some ingenuity it should be possible, however, to reduce such problems to "two-dimensional" ones. An example of how this may be done in the case mentioned in the foregoing now will be described.

The problem of the I beam is substantially that of a "built-in" beam. The "built-in" section *S-S*, Fig. 7, has to take up a bending moment and a shearing force. The stresses due to the shearing force are small as a rule as compared with the bending stresses and it is justifiable to neglect them. There still remains the complication that the stresses are acting in a horizontal plane to which *P* is perpendicular, Fig. 8. However, *P* can be approximated by a number of horizontal forces P_a as shown. It then is evident that one test with a model of the thickness t_a and subjected to a tensile force P_a will give the desired distribution

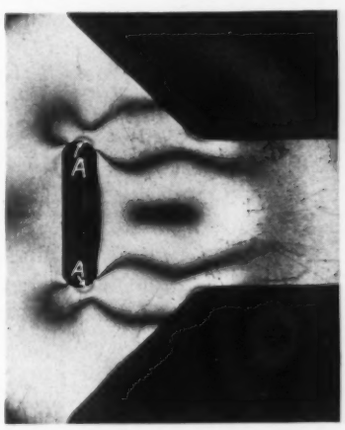
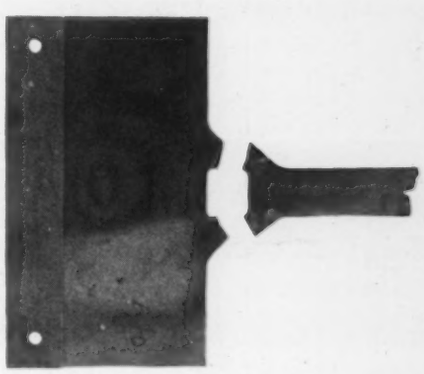


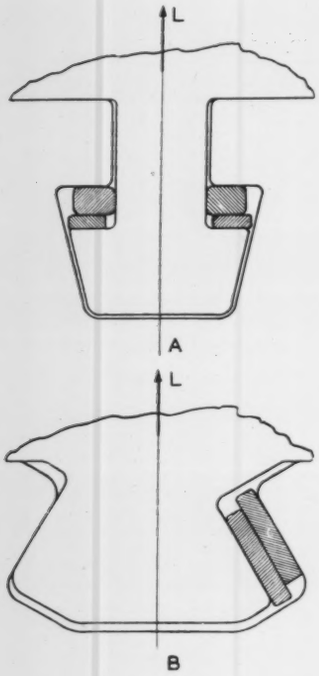
Fig. 9 (Left)—Top view of fillet weld model. Lines of equal shade are lines of equal principal shear stress. Fig. 10 (Below)—Fractured fillet model



of stress in all other horizontal slices.

Fig. 9 shows the celluloid model tested. The largest stress was found to be in points *A* in the slot. In subjecting the same model with which the photoelastic test was made to excessive loads, it was observed that it started to fail at the

point *A*. The failure was of the nature of a minute saw cut. This caused a secondary increase in the stress concentration, which in turn produced an increase in the size of the "cut." In this manner the failure progressed slowly about half way toward the 45 degree edge, until rather suddenly final failure occurred. The fractured



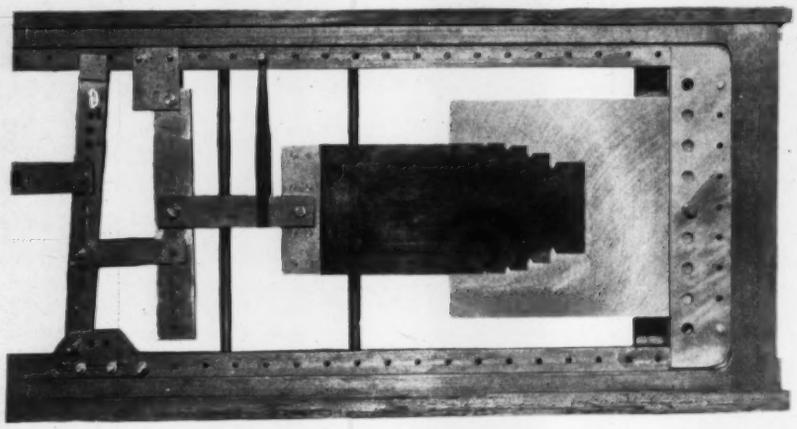


Fig. 11 (Left)— Fastenings for T-joint and dovetail. Fig. 12 (Above)— Testing an airplane propeller fastening

model is shown in Fig. 10.

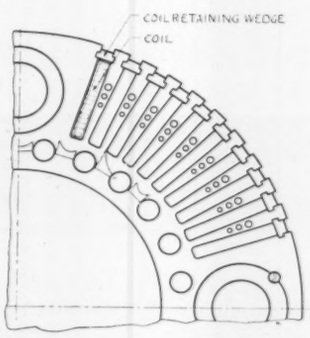
It became evident from these experiments that the slot is harmful insofar as the strength is concerned and therefore should be avoided. This can be done by shaping the ends of the web of the I beam parabolically and closing the space with weld material as completely as this is possible.[1]

In fastenings the problem is that of finding such a contour of the root that for a given load *L* the material used is a minimum. This appears to be a simple problem but in fact it is an extremely complex one, as it includes a large number of variables. The best that can be done at present is to make tests on different shapes and compile the data so obtained for future comparison.

Photoelastic tests that have been made so far include the root of turbine blades* and the contours shown in Figs. 11 and 12. Complete stress field investigations were made of the shapes shown in Fig. 11 with forces that were representative for assembly and centrifugal load.

The information so obtained is used by the designer (a) to compute yield and buckling strength and the radial displacement, (b) to derive empirical stress equations, (c) to make changes in design, (d) to compare different designs, (e) to locate suitable positions for bolt holes that are necessary in case of laminated joints.

Coil retaining wedges are the short beams that in turborotors are subjected to the centrifugal force of the coils, Fig. 13. Shapes frequently used are shown in Fig. 14. The question arose whether or not the beam formulas hold for the central section of such beams that have an unusually large width w as compared with their length *l*. On basis of photoelastic tests this could be answered in the affirmative for the ratios *l*/w that were involved. Attention is called however, to the fact that the design such as



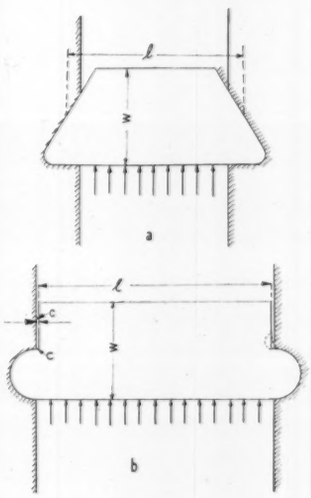


Fig. 13 (Above)— End view of turbine rotor. Fig. 14 (Right) — Coil retaining wedges

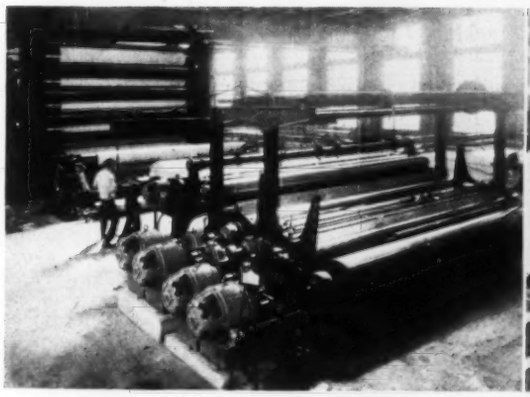
shown in Fig. 14-*b* results in excessive stresses in the corner *C*. This concentration can be reduced by making a fillet instead of the corner, if necessary a recantrant fillet as shown by dotted lines in Fig. 14-*b*.

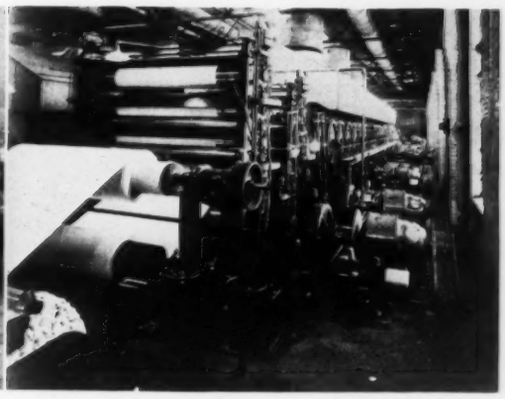
The tests further indicated that the strength

(*Concluded on Page* 52)

[1]Further photoelastic tests also were made of the stresses in the web of the I-beam, see "Strength of Welded Beam Connections" by Jennings and Jakkula, *Journal of the American Welding Society*, Vol. 9, No. 4, April, 1930.

*Figs. 5 to 7, November issue of MACHINE DESIGN, pages 30 and 31.





Figs. 1 and 2—Compactness and simplicity of mechanical construction are indicated in these drives on a four-drum winder and sectionalized paper machine

Single Versus Multiple Motor Drives

By P. W. Arnold

CONSERVATION of space, reduction of moving parts, flexibility of control, etc., are dealt with in the accompanying article. It has been written especially from the general angle of direct motor application, the author having had extensive experience in this field. In later issues of MACHINE DESIGN specific phases of this increasingly important problem will be treated.

DESIGNERS of power driven machinery must solve two problems which are, perhaps, outside the realm of true machine design. That is, problems aside from the design of cams, columns, gears, shafts and other mechanical parts. The problems referred to are those of selection of the power unit and the transmission of the power from its source to the point of application to the work.

Considering three general classifications of machinery: First, specialized high production automatic machines which make only one product; second, non-specialized machines, that is, machines which are required to do a wide variety of work; third, an intermediate group which might be called semi-automatic machines used in the manufacture of a limited range of similar pieces.

Any of these three classes may require a source of power giving constant or adjustable speed, quick stopping or fast and numerous reversals. A motor may even be desired to be stalled, thus holding a rotating part against a spring return.

The first problem of the machine designer is that of determining the form in which power is required by his machine. It follows then that the second is the choice of the driving unit giving the power in the desired form.

Types of motors available to drive these three classes of machines depend to some extent on the kind of power available, alternating or direct current. The former inherently gives one or more fixed speeds when a squirrel cage type of motor is used. This is the most common power source for small machines. Wound rotor slip ring motors give some speed variation but such motors do not find a wide application except in special instances.

If direct current is available and adjustable

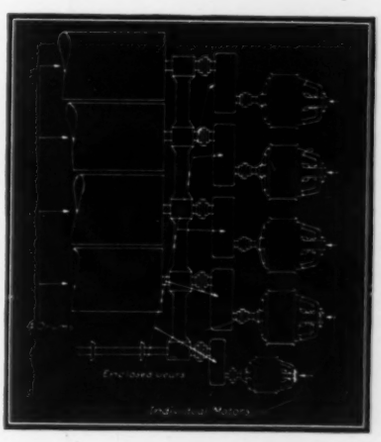


Fig. 3—Sketch of the four-drum paper winder illustrated in Fig. 1. Considerable space is saved and numerous parts are eliminated by the use of individual motors

speed motors are used, almost any kind of speed variation desired can be obtained.

Direct current motors are somewhat more suitable for quick stopping or reversing service, though many applications may be worked out with squirrel cage motors especially where frequent and numerous reversals are required.

In general the machines in the first group operate over long periods of one or two fixed speeds. It follows then that a motor of this type would be the best source of power.

Speed Variation Is Desirable

Some of the machines in groups two and three may operate at constant speeds even though doing a wide variety of work. A punch press for example falls in this class. The majority of the machines, however, will be required to operate at many different speeds if they are to give their maximum production efficiency. This is true of machines serving many industries. A small single spindle drill in a repair shop must operate at many and varied speeds to be efficient and so must a large machine in a paper mill.

The selection of the proper power unit is in itself a real problem and might require a lengthy discussion. Herein, however, ways and means of transmitting the power from its source to the point of application to the work is the prime consideration.

Considering the principal requisites of power transmission as:

1. Efficient transmission of the power
2. Limitation of moving parts to a minimum
3. Space saving
4. Flexibility of control
5. Maintenance of a low cost

The efficiency of the transmission of power cannot be calculated as the ratio of the power expended in production work to that put into the power unit. That is, true mechanical efficiency and such is important. However, the efficiency of greatest importance might be called the efficiency of production. Such efficiency is dependent for the most part on the application of the power to the work at the proper speed to produce the best possible product in the shortest possible time.

As stated in the foregoing, this problem can be solved easily in the case of automatic production machinery. A speed or set of speeds can be predetermined at which the machine will operate over long periods. One single speed motor may operate the entire machine, a multi-speed motor giving two, three or four fixed speeds may be required. Frequently to avoid the use of belts, gears or long and complicated shafts, two or more constant speed motors, synchronized through their control are used. A combination of any of the above mentioned may prove to be the economical arrangement.

For example there is the continuous rotary miller shown in Fig. 5. The two vertically mounted squirrel cage motors operate the two milling cutters and the horizontal motor rotates the table on which the work is mounted. The speed of each unit is independent of the others, yet all three are synchronized by their control.

Reduce Parts and Save Space

The second and third requisites actually go hand in hand and, in fact, are tied in with the first. A small number of moving parts and conservation of space make for overall efficiency.

Saving of space and limiting the number of moving parts usually means built-in or direct connected motors. There is a general tendency, that of placing the power unit nearer the actual point of application of the power to the work. Frequently one large motor is replaced on two or more smaller units when driving these through complicated systems of transmission equipment.

In Fig. 3 is shown a layout of a paper winder with four motors, each driving a separate roll. Note the compactness of the drive. In

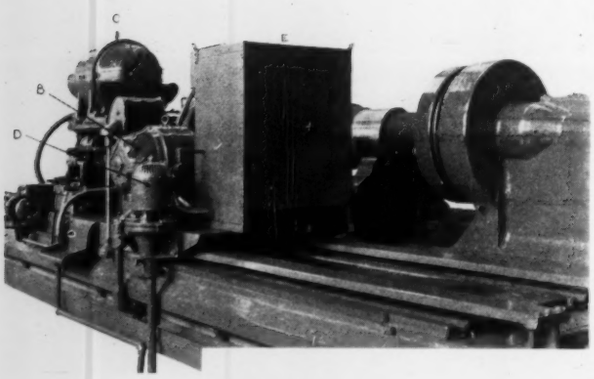
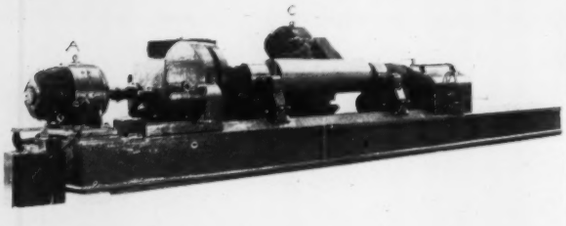
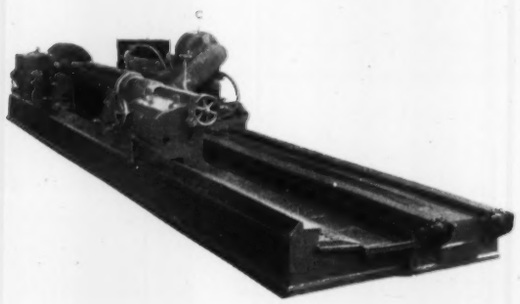


Fig. 4—Roll grinder driven by four motors. A operates headstock, B the traverse, C the grinding wheel and D the water pump



At rear of machine at E is shown the main control panel



addition to space saving and simplicity better and more flexible operation is secured. Fig. 3 shows the appearance of the winder with individual motors.

Fig. 4 shows several views of a large grinder with four individual motors, each performing a distinct operation. All motors except the water pump motor are the variable speed type and the speed of each may be varied independently of the others.

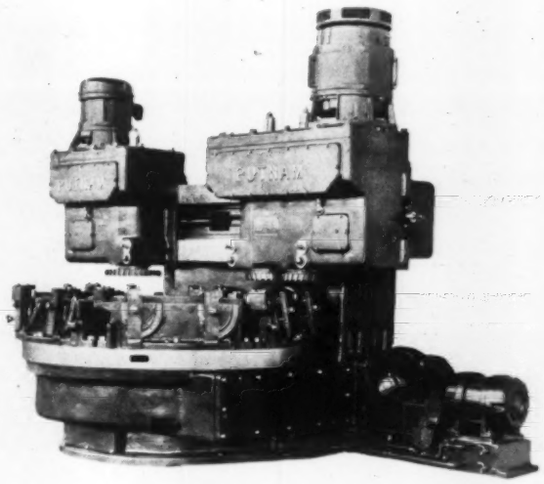


Fig. 5—Three motors are employed for driving this continuous rotary miller

Another application of individual motors not commonly known is that of synchronized individual motors. This can be accomplished by several different schemes. In general synchronized drives require speed variation, usually wide; due to this, variable voltage control frequently is used. For such systems a separate generator is set up to control a group of motors. The speed of the entire group can be varied by changing the voltage impressed on the motor armatures.

Dancer Rolls Control Rheostats

Varying loads, heating, etc. will cause speed variations in any of the individual motors and such cannot be permitted in a synchronized drive, as each motor must operate at exactly the same speed or else the material being handled will pile up or pull tight and break. The further synchronization is effected by individual rheostats in the field of each motor. Such rheostats are controlled by dancer rolls riding on the material passing through the machines. If the material drops down before it has a chance to pile up, the motor which slowed down is speeded up by the variation of resistance in its field. Conversely if it speeds up the dancer roll rises and slows down the motor which is running too fast.

Fig. 2 shows a paper machine with individual motors. These motors are synchronized by a sensitive control. Slight variations in speed will cause changes in the weight of the paper or breaks. Hence the motors must be synchronized perfectly.

The last of the five points is of utmost importance, for each designer must build a machine to sell in a competitive market. It must be remembered for example, that the fifty horsepower motor costs less than five ten horsepower machines. Also that it is quite possible that one fifty horsepower motor might have to be replaced by more than fifty horsepower in smaller units, as it may not be possible to take advantage of the same load factors.

Mechanical parts which can be done away with often balance the added motor cost. Space savings also justify additional first cost. Most frequently the overall expense, all factors considered, is equal.

It is impossible in such short space to go into individual motorization in each field. The examples shown are typical and the ideas basic and such that they will find applications on machines for every industry.

1930 Index Available on Request

THOSE subscribers who keep a permanent file of MACHINE DESIGN, will be interested to know that the index for 1930 now is ready for distribution. In addition to the usual contents index, covering the twelve issues of the year, the issues August through December are covered by an itemized index combined for these months. The index is furnished on request only.

For those readers who wish to have the twelve issues of 1930 with index bound in one volume, a limited supply is available at $9 each plus postage, or for $6 if the 12 issues are furnished by the reader. The volume is attractive as well as durable. It is bound in black and red leather, imprinted in gold.

New Standards Book Is Published

MOTOR and generator standards form the subject matter of a new book just published by the National Electrical Manufacturers association. This book is a valuable reference work of practical information on the manufacture, test, performance, and application of alternating and direct current motors and generators, frequency converters, and motor-generator sets of small and large power capacities.

Many of the rules and definitions have been approved as American standard by the American Standards Association, the NEMA having acted as sole sponsor or joint sponsor with other organizations. The volume may be obtained from the National Electrical Manufacturers association, 420 Lexington avenue, New York, at $1.50 per copy.

When Will Lubrication Cease To Be a Maintenance Problem?

DURING the past year MACHINE DESIGN has laid considerable stress on the importance of incorporating satisfactory lubrication equipment in design of all classes of machinery. It has been recognized that many reputable companies are giving serious thought to this problem and that design has benefited by the numerous lubrication systems now available. That there still is much to be done however, is evidenced by the number of papers treating this subject which were presented at the recent annual meeting of the American Society of Mechanical Engineers. Abstracts of two, which are given herewith, indicate the immense field open to engineers in providing satisfactory methods in original designs upon which they are engaged.

WHILE it is true that much of our progress in perfecting machinery is due to the discovery and developments of lubricants, the fact remains, however, that proper application to meet conditions is no less important. Adaptations and also changes in lubrication systems are being made where original design did not take into account new requirements of the machine.

In the papers on lubrication presented at the recent annual meeting of the American Society of Mechanical Engineers, this subject is treated from several different standpoints. Crane lubrication was discussed by Eustis H. Thompson, lubrication engineer, Baltimore Copper Smelting & Rolling Co., Baltimore. Reviewing the history of this phase of lubrication, he began with the period of increased production immediately following the World war. Repairs had been restricted previously to the lowest reasonable point, so that increased crane activity developed many weaknesses. It soon became apparent that lubrication was responsible for a large amount of delay and maintenance expense.

One of the first things to be done was to get the elementary matter of lubricating the cranes on a more dependable basis. In general, the cranes are equipped with hardened and heat treated gears, and in most cases ordinary cup grease gives a satisfactory life to the gear teeth.

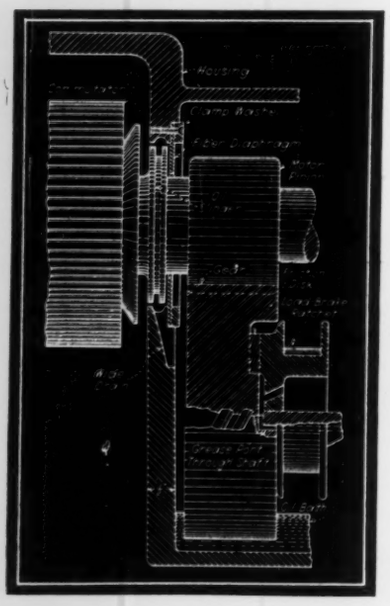


Fig. 1—A diaphragm and an oil thrower between the oil cellar and the commutator remedied trouble caused by oil thrown into the hoist armature of this mechanical l o a d brake

A sticky type of gear coating produces a film of high friction, but of immensely more resistant body. There also are lubricants on the market which combine the two qualities of heavy body and oilness. It would be difficult from a practical viewpoint to use a sticky gear coating in cranes, as it would doubtless reach bearings or other places where it would be objectionable. In some places the gear speed is too high for this material.

Several monorail cranes of obsolete design gave much trouble from losing hoist armatures due to oil leakage. The worst offender on one occasion required a hoist armature change each month for six months. A mechanical load brake operating in a bath of oil churned the latter up, throwing oil along the hoist armature shaft into the hoist armature. This was remedied by placing a diaphragm and an oil thrower between the oil cellar and the commutator, although there was very little room in which to install these devices, as shown in Fig. 1. The result was that armature life was extended to about six months.

An ideal way of overcoming this trouble would be to eliminate the mechanical brake and rig up an electric brake and dynamic braking system instead. Contrasted with the cost of

repairing armatures, this would appear to require a gigantic investment, however.

After trying to work out some solution that could be introduced almost without cost, a change in mechanical brake lubrication from oil to grease suggested itself. The load brake shaft then was equipped with a grease cup and drilled so that grease would be conducted to the friction surfaces. The oil tightening device was practically 100 per cent effective in keeping out the grease. A hole was placed in the load brake casing so that grease would not accumulate above a certain amount, as otherwise it would escape through this hole. All monorail cranes thus have been changed. As a result the armatures now operate in a bone dry condition and this oil trouble has been eliminated entirely.

L. A. Baudoin, assistant supervising engineer, Sinclair Refining Co., covered lubrication of textile machinery in his paper. Proper lubrication in this class of equipment is imperative because the performance required of the intricate machines used in the textile industry can be attained only when friction has been reduced to a minimum.

In many instances where a small number of large capacity machines could be replaced to advantage it has been done, and the lubrication features of these new machines are in line with the best practice today. For instance, ball and roller bearings are replacing plain babbitted journals on fan shafts and all load carrying bearings. Gear sets are well protected from dust and lint and so arranged that the cut gears run in a bath of oil, and in cases where first cost prohibits redesign to incorporate roller bearings, the ones provided are equipped with pressure gun fittings and reservoirs for grease besides provision to shield the bearings from the work so that the lubricant does not come in contact with the cotton fibers.

Mill owners and agents naturally consider cost of production. Operators and machine designers consider lightening the operation, convenience of handling, cleanliness and adaption to high speed when any new equipment is contemplated. Lubrication still is secondary and must give way completely to cleanliness. Lubricant manufacturers must work out the problem with existing equipment, but are insisting that, where necessary, future designs incorporate provision for an adequate supply of proper oil to suit that particular condition.

Chrome Nickel Steel Symbols Are Standardized

FIFTY-ONE steel producers have agreed to standardize specification symbols for chrome nickel steel produced within agreed analysis ranges. This outstanding co-operation movement on the part of steel producers exemplifies an increasing tendency towards standardization and clarifications for the benefit of customers. This action was accomplished by mutual concessions and unanimous agreement on the part of those companies producing chrome nickel steels under license by the Krupp Nirosta Co.

The decision to sacrifice several well known symbols in order that purchasers might buy material produced within standard ranges and designated by the same symbol, is only one of several instances during the calendar year wherein this group of companies has adjudged customer interests more important than individual trade marks. Their far-seeing attitude will undoubtedly result in mutual benefit, yet it is only within recent months that this type of progress has been accomplished within the industry. The adopted symbols with their ranges of agreed manufacturing analysis are reproduced below in such form that the tabulation may be retained for use in specification and purchasing.

Standardized Symbols for Nirosta, Designating Type of Steel Within Classifying Ranges

Base Symbols:

KA2 for austenitic chrome nickel alloys in the corrosion resistant field.
KNC for austenitic chrome nickel alloys in the heat resistant field.

For Wrought Material:

	C %	Mn %	S & P %	Si %	Cr %	Ni %	Mo %
KA2	.16 max.	.6 max.	.03 max.	.75 max.	16.5-20.0	7-10.5	....
KA2-S	.07 max.	.6 max.	.03 max.	.75 max.	16.5-20.0	7-10.5	....
KA2-H	over .16	.6 max.	.03 max.	.75 max.	16.5-20.0	7-10.5	....
KA2-Mo	.16 max.	.6 max.	.03 max.	.75 max.	18-22	7-10.5	2-4
KA2-SMo	.07 max.	.6 max.	.03 max.	.75 max.	18-22	7-10.5	2-4
KA2-HMo	over .16	.6 max.	.03 max.	.75 max.	18-22	7-10.5	2-4

The same symbols are used for cast material where Silicon max. limit is higher.

For Wrought and Cast Material:

KNC-3	.20 max.	.7 max.	.03 max.	2.0 max.	23-27	17-21	....

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments from Our Readers. Machine Design Will Pay for Letters Suitable for Publication

Design Is Basic Fundamental

To the Editor:

Your editorial "Design is the Basic Fundamental," is to the point. Undoubtedly the machine industry is a multisided activity in which many take part and do a useful share in carrying the load, but without good design, the best efforts of an organization will fail. The manufacturing department, the production man, the salesman and the management cannot overcome the handicap of poor design, for design is fundamental.

The designer goes to the very root of things. He usually starts work with nothing but an idea, but upon him rests the responsibility of creating a machine or apparatus that not only works. It must be safe, it must be efficient and it must be built for a cost that will meet competition. Even there, the designer's work has not stopped. Study of the machine in operation may suggest changes for improvement, new discoveries in the field of metals or materials or new methods of manufacture may make further changes or redesign necessary, and for all these things the designer is responsible.

It is fitting, therefore, that deserved credit be given the design profession. Too long the members of this profession have stood in the background while others less modest and deserving have come forward to accept honors for their contribution to industry.

—GEORGE FIELDING,
Wilmington, Del.

Systematic Catalog Filing

To the Editor:

EVERY modern and up-to-date designing department should maintain a catalog file for ready reference. So often does the designer refer to this file for various parts used in his design or to look at competitive design, that it is indispensable.

However, such a file may be a hindrance rather than an aid. It was among the writer's duties, some time back, to take care of a catalog file which was a regular nightmare owing to the system which had been adopted in the beginning. It contained some 900 to 1000 books, pamphlets and single page advertising correspondence. They were placed on three long shelves on the wall. Regardless of shape or size, they were numbered and placed consecutively on the shelf. Here would be some small pamphlets, then some single sheet advertisements, then some medium sized ones. These single sheets always were in a drooping position

101 4	111 1	121 1	131 3	141 1	151	161	171	181	191
102 3	112 4	122 2	132 2	142 1	152	162	172	182	192
103 1	113 1	123 4	133 2	143 1	153	163	173	183	193
104 1	114 1	124 1	134 1	144 5	154	164	174	184	194
105 1	115 1	125 1	135 1	145 1	155	165	175	185	195
106 5	116 2	126 3	136 1	146 3	156	166	176	186	196
107 2	117 1	127 2	137 2	147 2	157	167	177	187	197
108 2	118 1	128 5	138 1	148	158	168	178	188	198
109 4	119 3	129 1	139 4	149	159	169	179	189	199
110 3	120 4	130 1	140 3	150	160	170	180	190	200

Fig. 1—Card showing numbers allotted catalogs, sub numbers indicating sizes

GEARS	
1 5	Boston Gear Works
7 4	Foote Brothers Gear & Machine Co.
51 5	Charles Bond Co.
53 5	Formica Insulation Co.
59 1	Westinghouse Electric & Mfg. Co.
126 3	Earle Gear & Machine Co.
129 1	The Cleveland Worm & Gear Co.
147 2	Hartford Special Mach. Co.

Fig. 2—Listing of gear catalogs

and at best the whole affair made an unsightly spectacle.

Some time later the writer installed a simple system which up-to-date has proved satisfactory in every detail. It was found that catalogs ranged in the following approximate overall dimensions, 3½ x 6, 5½ x 7½, 4 x 9, 6½ x 9, and 8½ x 11 with an occasional rare one of larger size.

The foregoing sizes were grouped and given sub numbers as follows:

Size of catalog	Sub number	Example
3½ x 6	5	1^5
5½ x 7½	4	7^4
4 x 9	3	126^3
6½ x 9	2	147^2
8½ x 11	1	53^5

A card as in Fig. 1 is typed leaving a space in the upper right hand corner in which is placed the sub number according to size. It designates also that the number opposite has been used and cannot be used again. This card also can be referred to in case a catalog is misplaced, misfiled or lost.

If a catalog on gears comes in, under the Product Section in the card index, the last card titled gears—Fig. 2—is filled in. This then is

	Westinghouse Electric & Manufacturing Co.
25^1	Motors
47^2	Controls & Switches
59^1	Micarta Gears

Fig. 3—Cross-index card showing manufacturer

cross indexed under the manufacturers section as shown in Fig. 3.

When a later edition of an already tabulated catalog comes in it may be given the same number, discarding the first one, or may be given a sub number letter as for example 59^{1A}, 59^{1B} etc. Under the new system these catalogs are filed in drawers of a steel cabinet.

—F. A. FIRNHABER,
Waynesboro, Pa.

Shop Contact Is Advantageous

To the Editor:

MAY I add my enthusiastic endorsement of the value of shop contacts for the designer as ably recorded by Mr. Plastow in December MACHINE DESIGN. There is only one caution I would add from a long experience in carrying out this basic idea as a design executive. Such activity should be carried out with a spirit of confidence in the men and their own initiative, which should be entirely free of all check-up systems and records.

It is a grave mistake to try to reduce shop contact to a matter of keeping statistics. The men should feel free to go into the shop when such contacts appear to give promise of help, rather than to reduce them to mere regular "visits." This may mean several times in one day for a particular man on one job, and no times a day for the same day for another man. A contact should have at least one definite objective before it is undertaken—many more may of course develop—but mere aimless wandering to balance a record is wasteful and annoying to the shop.

—BERNARD F. MCCORMACK,
New York.

Specifying Machine Finishes

To the Editor:

IT OFTEN is difficult to convey a mechanical idea by words. A drawing is more satisfactory, but a model puts the idea over best of all. So it is with machine finishes. Judgment of individuals varies with their types and source of training, as well as with their individual preference. A set of standards, fixed in actual specimens of machine finishes and keyed in with the finish marks used on the drawings, alone remains fixed. Such a service standard will unify the finish and the product, save argument as to what finish should be used, and assure the correct finish definitely.

Opinions vary concerning the types of finish called for on drawings. What would be a smooth finish for one man would be rough to another. Therefore, if sample pieces of metal with required types of finish were furnished, the mechanics could compare their work with these. The pieces of metal should be kept in a place easily accessible to the men and preferably mounted on a board in the shop or stores.

—H. LACKMAN,
Philadelphia.

Welded steel pipes are replacing the usual ribs made of flat bars welded into notches on the outside of turbine generator frames, according to the latest construction practices. In addition to their structural advantages these tubes serve as air ducts, taking cooling air through the ends and discharging it through side holes.

Editorial

There's Much To Be Learned from the Other Man's Field

IN A span of a hundred years American locomotives have been developed from crude affairs, as typified by Peter Cooper's "Tom Thumb" of 1829-1831, into the efficient, reliable units which haul our heavy trains today. If all of the problems that were solved during that century of progress could be recorded, one would have a complete treatise on machine design because locomotive design, construction and operation involves the application of every known mechanical principle, experience with the majority of engineering materials, utilization of practically every method of production, fabrication and finishing of materials, and selection and use of numerous purchased parts and accessories.

The record of a century of locomotive development also would reveal a surprising relationship between motive power engineering and that of other fields. Ideas applied to locomotive design in the early days later found use in the development of other types of machinery. But the tide is being reversed. Many of the industries which profited from early locomotive experience now are contributing ideas to the designers of railroad motive power. The modern locomotive reveals the influence of automotive design in many minor details.

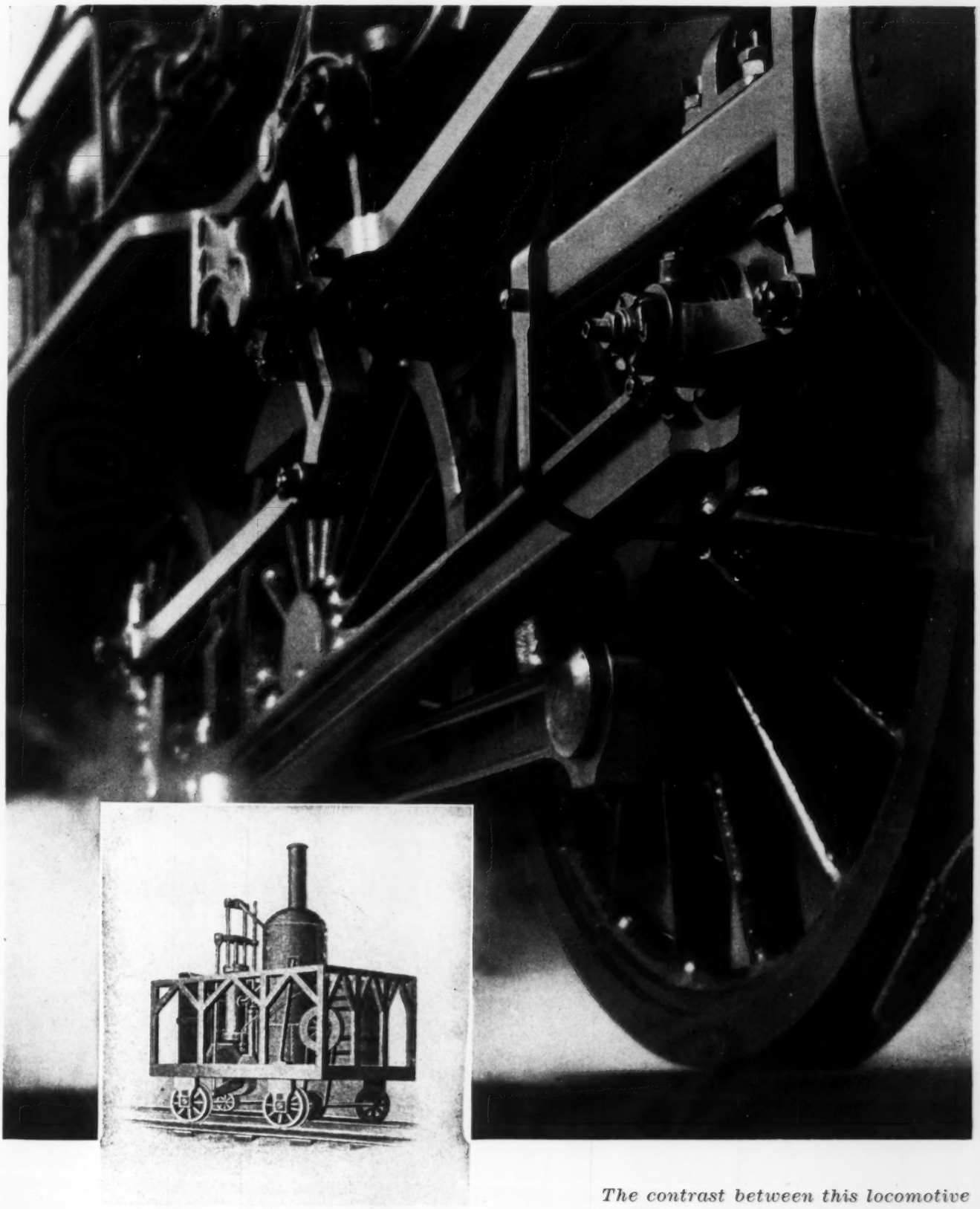
This continuous interchange of ideas will go on indefinitely, but at an ever increasing pace. It is a dominant characteristic of modern engineering which alert designers should recognize. You cannot afford to shut your eyes to what your contemporaries are doing in other fields.

Serving a Critical Public

The average American consumer will not tolerate annoyances which only a few years ago he accepted as necessary evils. He demands nonclashing gears, rattle-proof chassis and silent-running motor in his automobile. His refrigerator must not emit the one-time familiar hum. His wife's sewing machine must run quietly.

His ability to find these advantages in a few products is making him more critical of all mechanical devices with which he comes in contact. He reasons that if the whine of a small motor can be eliminated or silenced in one type of equipment it can be similarly removed on all installations. In his mind the same argument holds for the other annoyances.

The day of non-resonant gears, wheels and other rotary parts; of rubber (or other insulation) mounted motors, engines and other prime movers; of non-clashing transmission in all types of equipment; and of sound and vibration deadening devices on many machines is not far off. The manufacturer who does not prepare for that day will be at a serious competitive disadvantage.



A Century in Locomotive Design

The contrast between this locomotive of 1931 and its prototype of 1831 symbolizes a century of progress, in which applications of fundamental principles and use of improved materials, processes and parts have contributed to a great achievement in design

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

MECHANICAL movements such as the one to be described offer solutions to problems of converting rotary into reciprocating motion. This particular device was conceived and patented by Alban F. Shepard, Richmond, England, and recently was granted United States patent No. 1,783,589. By means of a rotary unit having an eccentric circular guideway, a reciprocating motion is imparted to the cross head. If desired a number of circular guideways may be so arranged on the rotary units and the invention, therefore, is particularly adapted to high speed engines. Compressor pumps are another application.

Fig. 1-*A* is a transverse section illustrating the device as applied to a single cylinder engine. *B* is a longitudinal section, *C* shows the device employed in an engine with two opposed cylinders, and *D* in an 8-cylinder engine. In *A* and *B* the fixed guide member 1, with its straight guideway 2, is centrally situated and the rotary shaft 3 has two duplicate rotary guide members or rotors 4. Axis of the cylinder 5 is in the middle plane of the fixed guide member. Piston 6 is connected by piston rod 7 to the cross head 8, which slides in the guideways 2. Fastened to and projecting from the cross head is pin 9. Slippers 10 are pivoted on the ends of the cross head pin and are arranged to slide in the grooves of guideways 12 of rotors 4.

The mechanism shown in *C* comprises two similar independent mechanisms with a rotary shaft common to both, the two rotor guideways being at 180 degrees difference. Provision is made for the inlet and discharge of fluid to and from the cylinders by way of the hollow fixed shaft 3, but this does not form any part of the invention. To reduce friction between the slippers and guides the inventor suggests any suitable means such as by white metal inserts, and the reciprocation of the cross head in its guide may be utilized for delivering oil to the working parts. In order to promote efficient lubrication of the inner surface of the guideways, the slipper ends are concaved. As the oil is swung around on the outside of the guides by centrifugal action, it meets the concaved surfaces and is swirled on the inner surface thereof.

A UNIQUE arrangement is incorporated in a cross tool slide mechanism for multiple spindle screw machines recently granted patent No. 1,783,528. Olof E. Trobeck, Berlin, Germany, is the inventor and the National Acme Co., Cleveland, the assignee. The object of the device is to provide an improved mechanism comprising a plurality of cross tool slides located one above the other but supported and operated independently.

In Fig. 2, *A* is an end view and *B* shows the de-

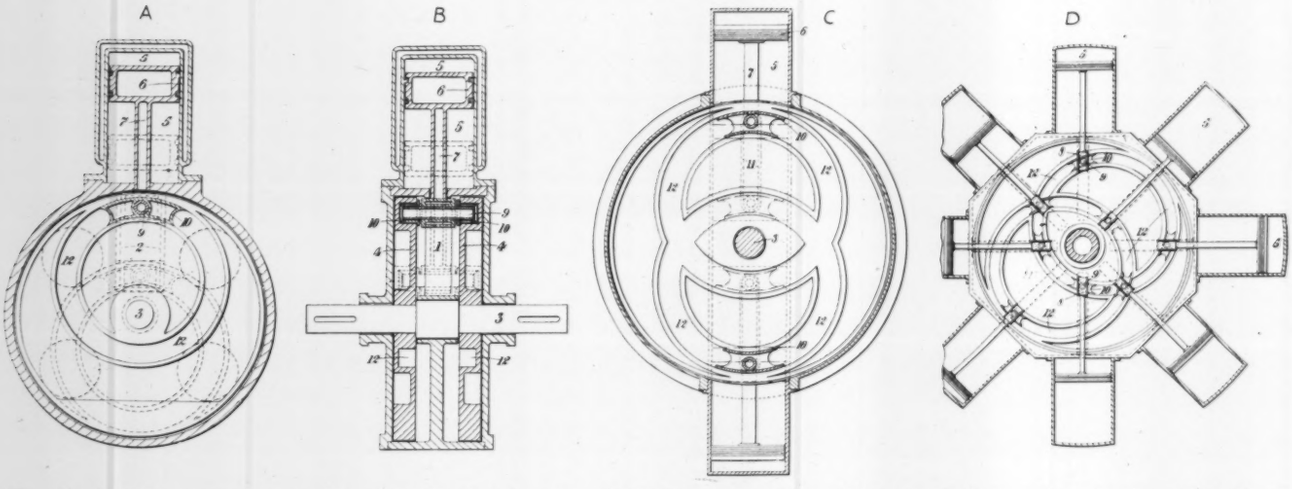


Fig. 1-A is transverse section of the device applied to a single cylinder engine. In the longitudinal section B may be seen the two duplicate rotary guide members. When used for a two-cylinder engine the device is designed as shown in C. The arrangement illustrated in D is for eight cylinders

vice partly in section. By use of the improved arrangement the working stroke or speed of the top tool slide can be adjusted as desired. The tool on the top slide may have double the speed or stroke as compared with the tool on the bottom slide or vice versa. Drum 5 carries the necessary and usual cams or straps 6 for shifting the bottom tool slide back and forth, these cams engaging a roller 7 carried by the bottom slide.

Bolted to the housing of the spindle carrier 2 is a bracket arm 11 for supporting the independent operating means of the top tool slide for operating upon the work. Located above this bracket is an adjustable top tool cross slide 12 carrying a tool holder 12′ provided with a tool 13. It will be observed that this top tool slide is supported or suspended for reciprocating

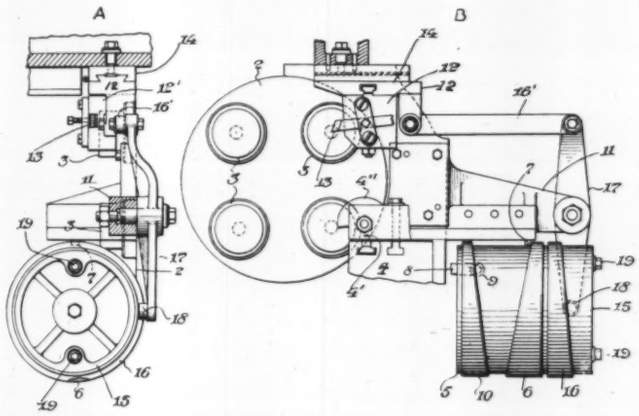


Fig. 2—A is an end view showing cross tool slide mechanism for multiple spindle screw machines. Drum 5 in B provides the cam movement

movement toward and from the work and for adjustment transversely of its sliding movement entirely independently of and free from the bottom tool slide. Movement of one is not imparted to the other and consequently the bottom tool can have a long or short movement as compared with that of the top tool.

PATENT rights recently were granted to Clarence C. Garrigus, Bristol, Conn., for his invention of a speed control apparatus for velocity transmission devices. The patent number is 1,782,990 and W. H. Bristol Talking Machine Corp., Waterbury, Conn., is the assignee.

The mechanism provides a centrifugal governing means and its object is to effect adjustment of a speed shaft and enable the adjusting means to be manipulated while the transmission and governing apparatus is in operation. Referring to Fig. 3, the motor 10 may be belted or geared directly to a rotatable pulley driving wheel 13.

Pulley 13 is mounted loosely on the shaft 14 and is arranged to be clutched in the following manner. A pair of friction disks 16 are provided to co-operate with its opposite faces, these disks being carried by flywheel 17 and flange 18 of the sleeve member 19. This sleeve is forced

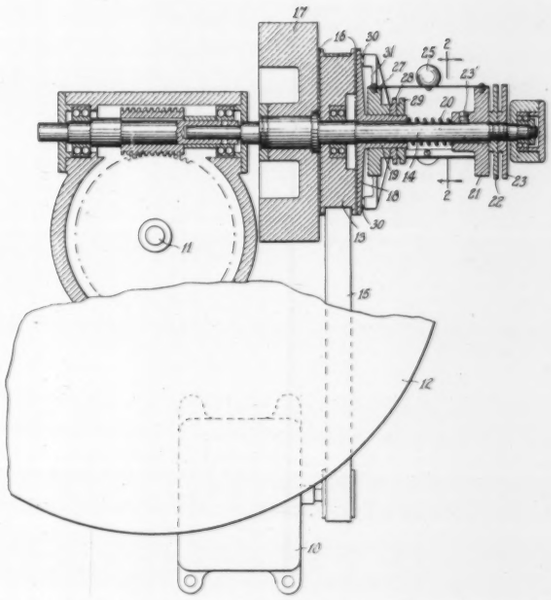


Fig. 3—Speed control mechanism which employs centrifugal governing means to effect adjustment of the speed shaft

toward the pulley and fixed flywheel by spring 20 coiled about the driven shaft 14. Collar 21 is mounted beyond the sleeve 19 as an abutment for spring 20. This collar may be adjusted to compress spring 20 to the extent necessary for securing the desired pressure on the clutch elements.

Close regulation of pressure is obtained through a centrifugal governor member comprising a series of fly-balls 25 mounted on resilient strips 26 and attached to abutment collar 21. By adjusting the member 27 the centrifugal governing member may be set to afford the desired speed. A braking device also is provided by a pair of friction shoes 30 carried by yoke 31. These shoes are adapted for engagement with flange 18 opposite to the one carrying friction disk 16, whereby the final exact speed may be obtained.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

BEARING CONSTRUCTION—1,782,710. Covered by this patent is the combination of a vertical shaft, a bearing enclosing the lower end of the shaft and having an oil reservoir vertically above, a pulley encircling the bearing below the reservoir, and air propelling fins on arms to circulate air past the reservoir. Assigned to Vorclone Co., Milwaukee.

ALLOY—1,783,139. A patent has been granted for a white alloy comprising the following proportions: Copper 66.554, nickel 18.2, zinc 14.5, aluminum 0.190, magnesium 0.190, cadmium 0.098, silicon 0.078, and manganese 0.190. Assigned to Charles Philippossian, Geneva, Switzerland.

ENGINE COMBUSTION CHAMBER—1,782,395. Comprising this invention are a cylinder, and a cylinder head having a combustion chamber therein and adapted to contain

the greater portion of the compression space for the cylinder. Valved inlet and exhaust means are provided at the head end and side of the cylinder, deflector means being associated with the inlet. Assigned to Bullington Engine Heads, Kansas City, Mo.

AUTOMATIC LUBRICATING JOURNAL BOX—1,786,104. A journal box having an axle with a lubricant distributing member thereon, and means for directing lubricant onto the bearing. Assigned to Isothermos Corp. of America, New York.

CLUTCH—1,786,708. This patent comprises in part a clutch mechanism, a shaft to be rotated, a driven element secured to the shaft, a driving element, a coupling member movable to driving position to operatively connect the elements and movable also to non-driving position to operatively disconnect the elements. Assigned to Crompton & Knowles Loom Works, Worcester, Mass.

THRUST BEARING—1,786,565. The combination of a plurality of self-lubricating bearings comprising a series of contacting disk-like members having flat surfaces with coinciding central aperatures provided for a shaft. A plurality of wedge-shaped grooves extend in spaced relation from each other on the flat surfaces of the disk-like members from their peripheries to their central aperatures. Assigned to American Telephone & Telegraph Co., New York.

VARIABLE SPEED TRANSMISSION—1,787,267. A unit comprised of a stationary element and driving and driven members. Concentrically arranged rings are carried respectively by the stationary element and driven member. A plurality of clutch elements engage each ring, and transmission means are provided for supporting the clutch elements adapted to transmit power from the driving to the driven member. Assigned to Galloway Engineering Co. Ltd., Hamilton, Ont.

ELECTRIC COUPLING—1,786,600. "A metal-clad electric coupling of the condenser orifice type comprising a conductor, a tubular condenser supported around said conductor, a metal casing around the condenser, and an inner member of impervious insulating material separate from the condenser." The inner member is attached to the conductor and forms a closed joint with the outer end or mouth of the metal casing. Assigned to A. Reyrolle & Co. Ltd., Hebburn-on-Tyne, England.

HARDENED self-tapping screws manufactured by the Parker-Kalon Corp., New York, are effecting appreciable economies for the Doehler Die Casting Co., Brooklyn, N. Y., it is revealed by a recent Nielsen survey. In vending machine assembly use of these screws eliminates tapping or casting a threaded hole in die castings. Labor cost is reduced between $0.10 to $0.75 per 100 screws used.

L. H. Morin, chief engineer of the Doehler company states in the survey that new applications are constantly being found for Parker-Kalon screws. Based on figures for several jobs in steady production a savings of about $720 a year is shown. Faster assembly with equal or greater strength also is obtained.

Photoelasticity—and Its Design Applications

(*Concluded from Page* 40)

can be increased by eliminating the clearance *c*. This makes the wedge more of the "built-in" type and a corresponding increase in strength therefore is obvious.

Stresses in turborotor teeth and endplates were studied photoelastically to determine whether or not it was safe to drill numerous holes in and below the rotor teeth for ventilation purposes, Fig. 13. From the results of tests this question also could be answered in the affirmative.

One of the most intricate parts of electrical machines insofar as mechanical design is concerned are commutators. There enter so many variables into these complex structures that it is difficult, even with perfect workmanship, to obtain consistently satisfactory performance in service. Therefore, however little any individual contributions to the knowledge of the mechanics of such structures appear to be, they may induce such changes in design that the roughness of the copper bars and the number of failures, such as fractures in spiders, bolts and rings, is reduced more and more.

To obtain a better conception of the distribution of loads and stresses in the copper bars, photoelastic tests were made. Fig. 3 shows the test in which the action of centrifugal force was simulated. In order to study the effect of the assembly force in "V-bound" commutators, the loading apparatus shown in Fig. 1 was used. One of the most important conclusions drawn from these tests concerns the distribution of the load. It was found that the load is more or less concentrated over a small contact area close to the commutator neck. After all, this is to be expected due to deflection of the tapered beams, but the tests have indicated just where the true location of the forces should be assumed.

The author wishes to acknowledge his indebtedness to J. M. Lessells, manager of the mechanics division, and other members of the staff for valuable suggestions; particularly to Dr. Timoshenko for the interest he has shown and the cowork in the solution of some of the earlier problems.

AN electric gage which measures one one hundred thousandth of an inch, and then magnifies that infinitesimal dimension 10,000 times so that the average workman may speedily and accurately read the result, has been developed by the general engineering laboratory of the General Electric Co., Schenectady, N. Y. The new gage is suitable for almost any type of measurement, with certain changes in set-up.

Assets to a Bookcase

Review of Books Pertaining to Design

Interesting Bearing Data

Bearing Metals and Bearings, by W. M. Corse; cloth, 383 pages, 6 x 9 inches; published by Chemical Catalog Co. Inc., New York, and supplied by Machine Design for $7.00 plus 15 cents postage.

This book was prepared by Mr. Corse at the suggestion of the committee in charge of the monograph series of the American Chemical society. It is his aim to aid readers in gaining an idea of the fundamental principles involved in the selection of bearings and bearing metals.

Beginning with the history of early developments in this field, he traces the progress that has been made. Three types of bearing metals, the white metals, bronzes and graphite, are selected for profound consideration.

Of factors deciding choice of bearing type, he says: "The prospective user will do well to consider carefully the use to which bearings will be subjected before making a selection. Bearing troubles and failures may be traced to one or more of the following causes: Faulty design of bearing, materials unsuited for the service, improper lubrication and incorrect methods of manufacture."

Testing bearing metals and bearings is covered and a section is devoted to lubrication. A bibliography and abstracts of selected papers on bearing metals and bearings are presented. The book concludes with 14 pages of tables giving the properties of bearing metals.

□ □ □

On Basic Machine Elements

Elements of Mechanism, by Peter Schwamb, Allyne L. Merrill and Walter H. James; cloth, 372 pages, 6 x 9 inches; published by John Wiley & Sons Inc., New York, and supplied by Machine Design for $3.50 plus 15 cents postage.

Conceived with a purpose toward selecting the relatively more common and fundamental machine elements and studying their motions when combined in certain definite ways, this book recently was rewritten and published in its fourth edition. Principal changes in the text include the restoring of the discussion on linear velocities to an earlier chapter in order that its principles may be employed in the treatment of gearing, wheel trains, etc.

The subject matter on chain drives was rewritten completely and more extensive treatment was given to the universal joint. Revolving oscillating bodies, motions and velocities, belts, ropes and chains, transmission of motion, gears and gear teeth, inclined plane, wedge, screw, cams and linkwork are among the topics considered in the volume.

□ □ □

Valuable Book on Materials

Materials of Engineering, by H. F. Moore; cloth, 409 pages, 6 x 9 inches; published by McGraw-Hill Book Co. Inc., New York, and supplied by Machine Design for $4.00 plus 15 cents postage.

A study of materials used by engineers is provided by this book which covers methods of manufacture, fabrication into machines or structures, requirements of service which these materials must meet, methods of testing and inspection.

The fourth edition recently was published and its principal changes include replacement of a chapter on failure under repeated stress by three chapters on elastic failure, failure by creep and failure by fracture. Additions have been made to the chapter on inspection and testing describing recent types of testing machines. Values for strength, ductility and other physical properties of materials also have been revised.

□ □ □

Authoritative Standards

Standards of the American Society for Testing Materials, 1930, in two volumes, Part I-Metals and Part II-Nonmetallic Materials, 1000 and 1214 pages respectively, 6 x 9 inches, cloth or half leather, published by the American Society for Testing Materials, Philadelphia, and supplied by Machine Design, Cleveland, for $7.50 for each volume singly or $14 for both parts in cloth; half leather, $9 each volume singly or $17 for both parts, postage 15 cents per volume extra.

Every three years the American Society for Testing Materials issues its new edition of authoritative standards for engineering materials. Part I on metals contains 179 standards covering steel, wrought iron, pig and cast iron, ferroalloys, nonferrous metals, and miscellaneous subjects. Part II on nonmetallic materials contains 251 standards on cement, tile, lubricants, rubber products and insulating materials and other miscellaneous materials.

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

VARIOUS problems which are basically related to design of machinery were among the multifarious topics discussed at the annual meeting of the American Society for the Advancement of Science held recently at Cleveland. Scientists attending numbered 5000. The exhibition included demonstrations of the photo-electric cell and laboratory apparatus. Noise measuring and recording apparatus provided an interesting study and much equipment incorporating new design features was exhibited. Mathematical calculations on which machine design depends for solutions of many problems also constituted part of the discussions. Although the convention as a whole was extremely scientific, the accomplishments revealed will bear influence on what is done in development of many types of machinery in the future. Dr. Robert A. Millikan, chairman of the executive council of the California Institute of Technology, was among the speakers at the meetings.

* * *

Decide Location of Hydraulic Laboratory

THE proposed hydraulic laboratory of the federal bureau of standards, the first in the country to be devoted exclusively to research, will be constructed on a site south of the bureau's radio building in Washington. Congress has authorized the expenditure of $350,000 on this hydraulic building, but decision as to the style of the structure to be adopted rests upon selection of one of two plans. The sum of $300,000 will be expended upon the building and the remainder upon permanent equipment.

* * *

Issues Agricultural Engineering Directory

INTERNATIONAL Institute of Agriculture at Rome has compiled a world directory of institutions engaged in agricultural engineering activities. The directory shows the individual institutions, the principal projects upon which each is engaged, and the names of the engineers in charge of the various activities.

* * *

Various New Metals and Alloys to Be Shown

EXHIBITS of new metals and alloys are expected to command interest and close study at the thirteenth exposition of chemical industries which will be held at Grand Central Palace, New York, May 4-9. During the two years since the last exposition long strides have been made in commercialization and use of highly specialized alloys.

Demands of the automobile industry have brought forth many alloys. Mining machinery also has been instrumental in their multiplication to combat hard rock and corrosion of mineral laden waters. In aircraft strength coupled with extreme lightness and resistance to corrosion have been met by innovations in the field of metals, developments in which will feature the exposition.

* * *

To Destroy Abandoned Patent Applications

BY authority granted by congress to the commissioner of patents, 20-year accumulations of abandoned patent applications are to be destroyed. More than 750,000 files of such abandoned applications are to be returned to the applicants or destroyed within the next six or eight months. These files are estimated to weigh 200 tons. They have been accumulating at the rate of about 30,000 abandoned applications yearly. The patent office has had to erect over 25 miles of shelving in the present building to take care of the patents and files of patents granted since the institution of the patent system. It was reorganized in 1836, since which time the patents granted have reached the number of 1,787,423.

* * *

Improvement Is Up to the Engine Designer

"WHEN the car designer will so lay out his fuel system that gasoline temperatures of 200 degree Fahr., as have been observed at times, are impossible, the problems of the gasoline refiner will be reduced and the satisfaction of the car owner increased," Dr. O. C. Bridgeman, bureau of standards, declared recently in an address before the Philadelphia section of the Society of Automotive Engineers. "No reason exists why fuel systems cannot be so designed that the maximum temperature of the gasoline in the system will not rise more than 30 degrees above the temperature of the atmosphere. With all cars meeting this condition, the

conflict between ease of starting and vapor lock will be minimized," he said.

"Improvements are also possible to a lesser degree in manifold design and its relation to distribution of the fuel mixture. A parallel case is a general improvement of the combustion chamber design so that higher compression-ratios can be employed without necessitating gasolines of abnormally high anti-knock value. There are at present on the market cars of high compression-ratios which do not require fuel of as high an anti-knock value as do other cars of lower compression-ratios, indicating the importance of combustion chamber design."

* * *

Invents Device for Spraying Metal Coating

SPRAYING of a thin coating of metal over wood, glass or celluloid bases is accomplished by a gun invented by Dr. M. U. Schoop, famous Swiss scientist. He believes airplanes in the future can be constructed of fireproof wood. Sprayed molten metal, distributed by a machine that looks much like a hand torch, makes the wood of celluloid free from fire, protects against weather and increases its strength. Dr. Schoop several times has been honored by Franklin institute, Philadelphia, for his contributions to science.

* * *

Sees Tremendous Advance in Airplanes

PREDICTION of a super-plane flying 5000 miles an hour and crossing the Atlantic in a 3-hour flight has been made by Dr. Fritz von Opel, son of Germany's leading auto builder and first to ride in a rocket car and fly in a rocket plane. He believes this will be accomplished within 20 years and figures that foolproof planes will be perfected in five years; then will come the rocket. Ordinary motors would carry the rocket plane to heights where the air becomes too thin. Rockets then would be ignited to carry the ship forward. Airtight cabins would be provided with artificial respiratory apparatus for passengers.

* * *

Interest in Welding Contest Is Widespread

IMPORTANCE and far-reaching effects of the second Lincoln arc welding prize competition, recently announced by Lincoln Electric Co., Cleveland, was demonstrated recently in a survey of inquiries made to the sponsoring company for further details on the competition. Of particular significance in this survey of inquiries, which number well into four figures, is the variety of industries covered, and the interest shown in foreign countries.

Requests for further information cover practically every known industry, and are distributed over a wide range of industrial positions. Queries were received from 17 foreign countries, including Japan and China in Asia, most of the European countries, Australia, Union of South Africa, and several countries of the western hemisphere. A majority of the replies from foreign lands came from Germany.

The prize competition was announced approximately six weeks ago and is designed to stimulate designers and engineers in every line of industry to consider the application of arc welding to the manufacture of their own product. Awards totalling $17,500 will be divided into 41 prizes. The contest closes Oct. 1, 1931, and is open to anyone in the world except employees of the sponsoring company.

* * *

Commemorates Anniversary of Founding

COMMEMORATING the fiftieth anniversary of the founding of the Bullard Co., Bridgeport, Conn., an oil portrait of Edward Payson Bullard, the founder, and a bronze tablet recently were placed in the lobby of the new administration building. Mr. Bullard, a recognized genius in machine design, established in 1880 the Bridgeport Machine Tool Works. In 1894 the company was incorporated as the Bullard Machine Tool Co. and in 1929 the name was changed to the Bullard Co. Its brilliant 50-year record is characterized by progressive achievement in design, development and manufacture of machine tools.

* * *

Design Feature of New York Motor Salon

DISTINCTIVE design characteristics were evident at the million dollar motor solon held at Hotel Commodore, New York, in December. Average sales price of each car was $9000. Some had 8, others 12 and still others 16-cylinder engines. Most of the cars were built closer to the ground than the old models, seeming even lower since running boards are eliminated and doors run down to the bottom of the sills. Slanting V-shaped windshields continue in vogue, although passing out in Europe. Greater use is being made of stainless steel and chromium plating in metal trim both inside and out of the car. More convertible bodies are being shown this year, convertible coupes predominating.

* * *

Announces Objects of Technical Department

OBJECTIVES of the newly formed technical department of the Gray Iron Institute Inc. were announced in a recent bulletin. Work to be undertaken immediately will include the collaboration with other technical societies and committees to bring to members all that is being done in the way of committee work. It will commence testing bars that have been submitted by members of the institute and report the results of tests in the form of a bulletin. Specifications will be established. This will not only correctly identify the properties required of a casting, but will suitably classify gray cast iron.

MEN OF MACHINES

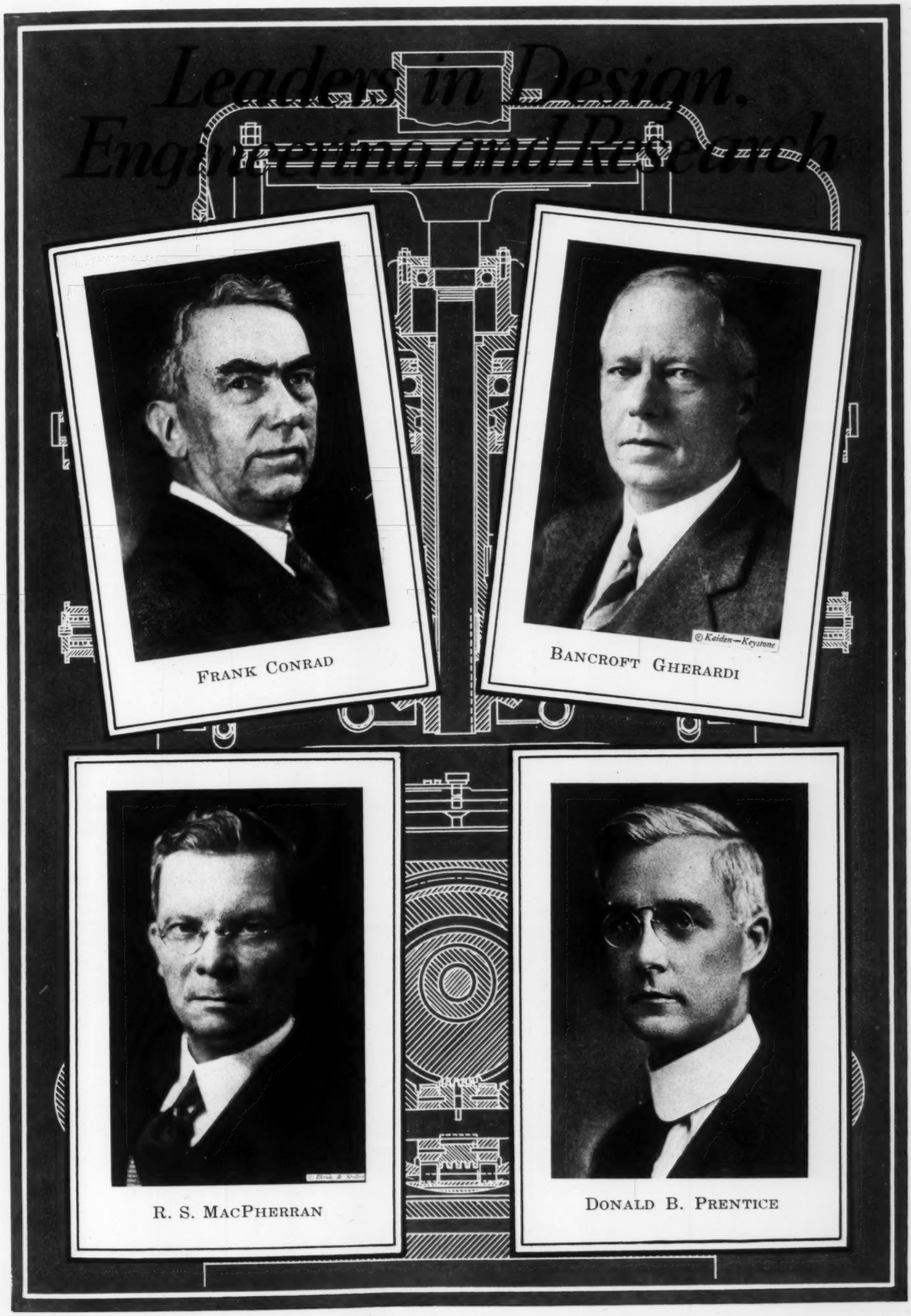
Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

AWARD of the Edison medal which is presented annually for meritorious achievement in electrical science, engineering or the electrical arts, has been made to Frank Conrad, Pittsburgh, for his radio achievements. A committee of 24 members of the American Institute of Electrical Engineers chose Dr. Conrad to receive the medal. Born in 1874 in Pittsburgh, he joined the Westinghouse Electric & Mfg. Co. in 1890. Rising rapidly in the organization, he entered the laboratory after several years as an assistant in the shops. During this stage of his work he invented a number of forms of switches, lightning arresters, and breakers for use in alternating current work, being closely associated with, and later in entire charge of the arc lamp design department. This was his first engineering work. Dr. Conrad was appointed a general engineer of Westinghouse in 1904 and was promoted to the position of assistant chief engineer in 1921. In 1925, he was awarded the Morris Liebmann memorial prize of the Institute of Radio Engineers for his early work in connection with high frequency transmission. He is a fellow of the Institute of Radio Engineers, a member of the Society of Automotive Engineers, and a member of the American Association for the Advancement of Science.

ELECTION of Bancroft Gherardi, vice president and chief engineer of the American Telephone and Telegraph Co., to the presidency of the American Standards association was announced at the recent annual meeting of the organization in New York. Born in San Francisco, April 6, 1873, Mr. Gherardi was graduated with the degree of B.S. from the Polytechnic Institute of Brooklyn in 1891. In 1893 he received his M.E. degree at Cornell university and the degree of M.M.E. in 1894. He entered the employ of the New York Telephone Co. in 1895 and in 1901 he became chief engineer of the New York and New Jersey Telephone Co. Serving in that capacity until 1906, he was made assistant chief engineer of the New York Telephone Co. and New York and New Jersey Telephone Co. In 1918 he was appointed acting chief engineer and shortly thereafter, chief engineer, becoming vice-president and chief engineer of the American Telephone and Telegraph Co. in 1920. Mr. Gherardi is past president of the American Institute of Electrical Engineers, and has also served as president of the United Engineering society. He has been an active member of the board of directors of the American Standards association since the organization of the board in the latter part of 1928.

THE J. H. Whiting gold medal of the American Foundrymen's association has been awarded to Ralph S. MacPherran, one of the outstanding metallurgists in the field of cast iron, for his contributions to the foundry industry. For many years he has been a prominent and active contributor to the committee work of the American Foundrymen's association and the American Society for Testing Materials, having been identified with the iron and steel industry for nearly 30 years. Born Feb. 1, 1871, Mr. MacPherran received his technical education at the University of Wisconsin and University of Michigan, graduating from the latter institution in 1892. In 1895 he became connected with the E. P. Allis Co. of Milwaukee. Leaving that firm in 1907, he spent one year with the J. I. Case Threshing Machine Co., Racine, Wis., after which he returned to the newly formed Allis-Chalmers Mfg. Co. He has been associated with that organization ever since in charge of its physical and chemical laboratories. Besides the organizations previously mentioned Mr. MacPherran is a member of the American Society for Steel Treating, International Society for Testing Materials and American Chemical society.

BEGINNING February 1, Prof. Donald B. Prentice, dean of Lafayette college and head of its department of mechanical engineering, will become president of Rose Polytechnic institute, Terre Haute, Ind. He assumes the duties of his new post with a broad background in engineering education. Prior to his affiliation with Lafayette college, he was assistant instructor in mechanical engineering 1912-14 and instructor 1914-17 at Yale university. His first work at Lafayette was that of assistant professor, after which he became professor and head of the mechanical engineering department of that institution. Born April 27, 1889, at Hartford, Conn., Prof. Prentice obtained his collegiate education at Sheffield Scientific school, Yale


Leaders in Design,
Engineering and Research
FRANK CONRAD
© Kaiden—Keystone
BANCROFT GHERARDI
R. S. MACPHERRAN
DONALD B. PRENTICE

university. He was graduated with a Ph. B. degree in mechanical engineering in 1910 and received his M. E. degree in 1914. From 1910-14 he was connected with the Britton Co., Hartford. Prof. Prentice has a keen interest in engineering, having been a delegate to the World Engineering congress in Tokyo in 1929. His work as a teacher of machine design brings him in close association with what is being done in this field. Organizations to which he belongs include the American Society of Mechanical Engineers.

* * *

Cloyd M. Chapman, engineering specialist of New York, recently was re-elected to the vice-presidency of the American Standards association for the year 1931. Mr. Chapman entered the employ of Thomas A. Edison in 1899 as assistant in his private laboratory on experimental work. He has been engineer for Westinghouse, Church, Kerr & Co. in charge of design and construction work and as engineer of tests.

* * *

Robert C. Sessions has become affiliated with Frank L. Sessions, consulting engineer, with headquarters in the Rockefeller building, Cleveland. Until recently Robert C. Sessions was engineer in charge of engineering and experimental division of Steel & Tubes Inc., Cleveland. They will practice consulting mechanical and electrical engineering.

* * *

W. E. England, former chief engineer of the F. B. Stearns Co., Cleveland has been added to the engineering staff of the Houde Engineering Co., Buffalo, manufacturer of shock absorbers and other metal specialties.

* * *

Lee E. Allen, chief engineer and secretary, Pennsylvania Engineering Works, New Castle, Pa., has been elected president of the Engineers' society of New Castle.

* * *

J. Otto Scherer has severed his connection as chief engineer with the Junkers Corp. of America, New York, and entered the independent field as a consulting engineer in Detroit.

* * *

A. L. Kimball and J. Ormondroyd have been appointed lecturers on vibration problems at Harvard Engineering school, Cambridge, Mass., where a new course is being given on mathematics and physics of vibrations in high speed machines. Mr. Kimball is associate head of the mechanics section of the General Electric research laboratory at Schenectady, N. Y. Mr. Ormondroyd is manager of the experimental engineering division of the South Philadelphia works of the Westinghouse Electric & Mfg. Co.

* * *

C. R. Paton has relinquished his position as a member of the research department of the Studebaker Corp., South Bend, and accepted a post in the experimental engineering department of the Packard Motor Car Co., Detroit.

* * *

F. J. Foster recently assumed the duties of experimental engineer with the Muncie Products division of General Motors Corp., Muncie, Ind. He previously served the Lycoming Mfg. Co., Williamsport, Pa., as engineering representative for production.

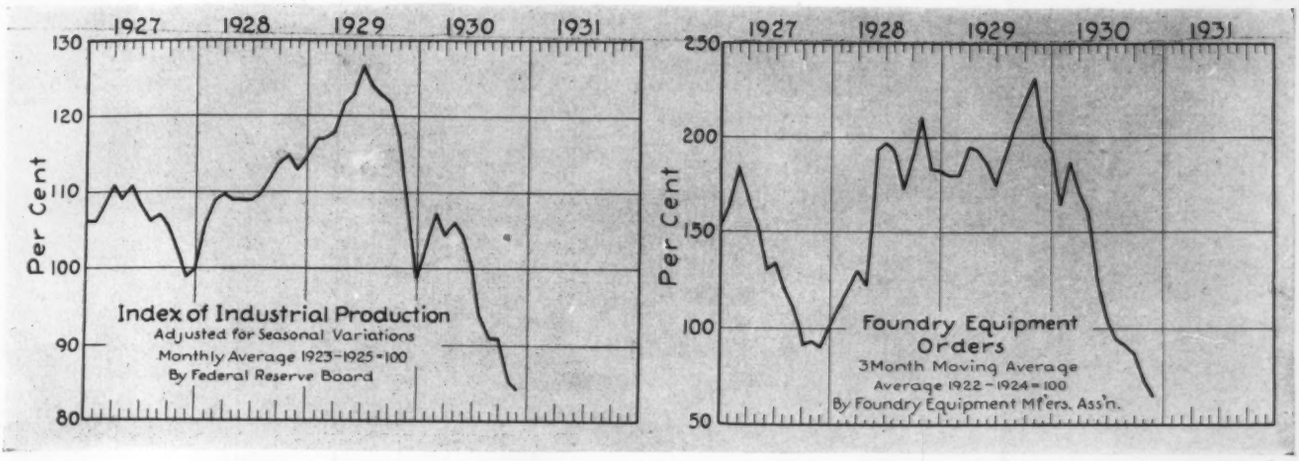
* * *

T. M. Carpenter, general manager of the crankshaft division of General Motors Corp., Saginaw, Mich., has been elected vice president and general manager of the Jackson Motor Shaft Co., Jackson, Mich., recently acquired subsidiary of the Muskegon Motor Specialties Co. Mr. Carpenter has been connected with General Motors 13 years and is an expert in crankshaft design and manufacture.

A.I.E.E. Officers Nominated

THE national nominating committee of the American Institute of Electrical Engineers, consisting of 15 members from various parts of the country, has nominated the following official ticket of candidates for the offices falling vacant August 1, 1931:

President, C. E. Skinner, assistant director of engineering, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; vice presidents, W. B. Kouwenhoven, professor of electrical engineering, assistant dean of the engineering school, Johns Hopkins university, Baltimore; W. E. Freeman, assistant dean, college of engineering, head, department of electrical engineering, University of Kentucky, Lexington, Ky.; Paul H. Patton, telephone engineer, Northwestern Bell Telephone Co., Omaha, Neb.; A. W. Copley, engineering manager, Pacific coast district, Westinghouse Electric & Mfg. Co., San Francisco; L. B. Chubbuck, switching equipment engineer, Canadian Westinghouse Co., Ltd., Hamilton, Ont.; directors, L. W. Chubb, director, Westinghouse research laboratories, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; B. D. Hull, engineer, Southwestern Bell Telephone Co., Dallas, Texas.; H. R. Woodrow, electrical engineer, Brooklyn Edison Co., Inc., Brooklyn, N. Y.; treasurer, W. I. Slichter, professor of electrical engineering, Columbia university, New York.

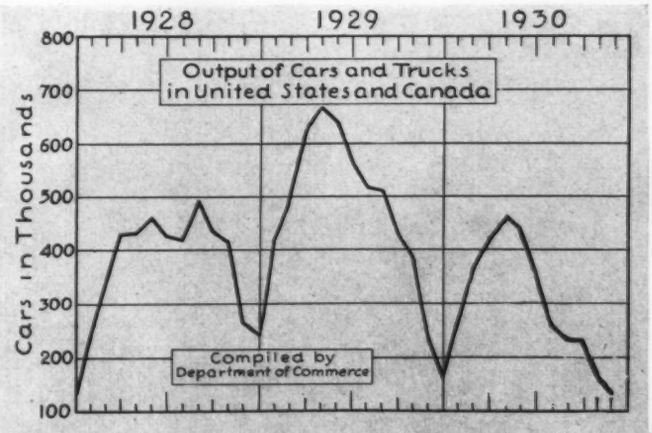


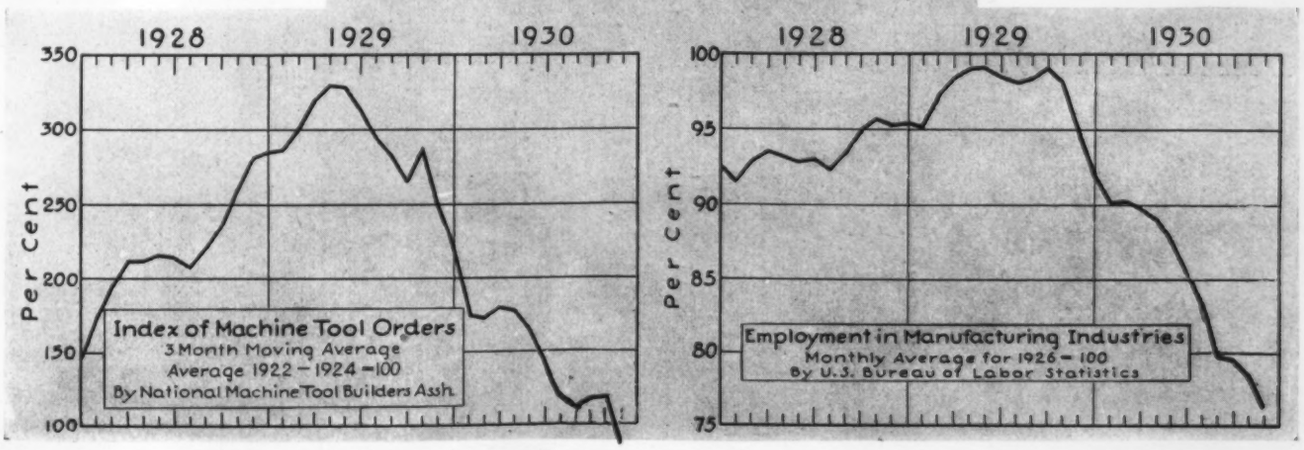
How Is Business?

ACTIVITY in industry at the beginning of 1931 remains in a depressed state with the world at large anxiously awaiting an early return of prosperity. The situation in virtually every phase of business is the same, the machinery field included. Production of equipment is dragging bottom, but confidence is being maintained even though immediate business is not promising.

Engineering activity continues unabated with the hope that new developments hold the key to business revival. Among the important factors which seem a certain aid to recovery is research. The scientist, the research worker and above all the designer will play a great part in introducing new equipment on the market. The machine tool industry affords a good example of what research and redesign is accomplishing. Employment services report within the past month the placing of a considerable number of designers and draftsmen. The understanding in most cases, however, is that the work will be temporary unless routine engineering department activities revive before the special work is completed.

Present prospect for a sharp increase in steel prices is remote. Relatively low price levels are expected by economists to continue. Reductions in prices, however, have not affected wages except in a few instances. Automotive activity shows an increase and a large midwest machinery manufacturer reports unfilled orders ahead of last year.





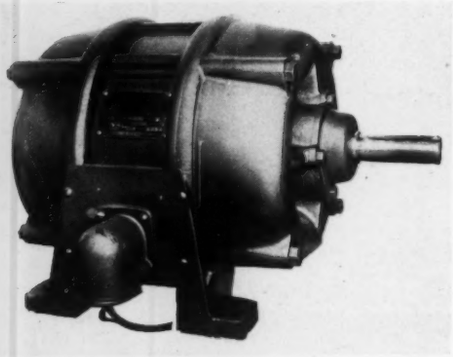
NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Unique Design Features Motor

UNIT type construction is an outstanding feature in the new series of electric motors recently developed by the Ideal Electric & Mfg. Co., Mansfield, O. These motors present many new design characteristics and can be built into machinery. They are furnished in sizes from ½ to 200 horsepower.

By placing the motor feet on the bearing brackets all load shocks and strains are carried directly to the motor support. Since the bearing brackets support themselves the only mechanical load on the stator is the motor torque. When the front end bracket and stator are removed, the pulley end bearing bracket remaining bolted to the base still will support the rotor and gear, pulley, or other connection to the driven machinery.



Motor built from standard parts suitable for other types

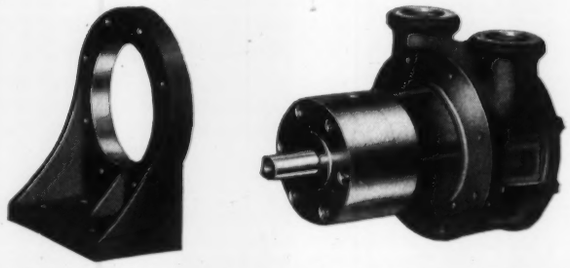
These motors are built with standardized units (rotors and stators) which are interchangeable for all types. Thus standard horizontal motors, shell type motors, flange type motors, vertical motors, special applications of "built in" motors requiring only the active elements, etc.—all take the same rotors and stators. These same standardized rotor and stator units are used to build open type motors; splash-proof motors, drip-proof motors, totally enclosed fan-cooled motors with running seals or stationary seals; explosion-proof motors; shaftless motors, etc.

Interchangeable ball, roller or sleeve bearings; antifriction bearings are supplied as standard. The ball and roller bearings are of the cartridge type, so constructed that the motor can be taken down without dust or dirt entering the bearing. The sleeve bearing housings are of a new design that can be rotated for wall or ceiling mounting without removing the bearing brackets and these sleeve bearings can also be replaced without removing the bearing brackets or dismantling the motor. Bearings are centrifugally cast with a hard glazed finish. Oil grooves inside the bearing lining for properly distributing the oil film are machine cut. Bearing housings have large oil well capacity with caps to provide a definite oil seal.

Pump Employs Ball Bearings

ANNOUNCEMENT just has been made of the new ball bearing model CP oil pumps recently perfected by the Tuthill Pump Co., Chicago. Although primarily intended for hydraulic applications, the units also are suitable for handling all lubricating liquids.

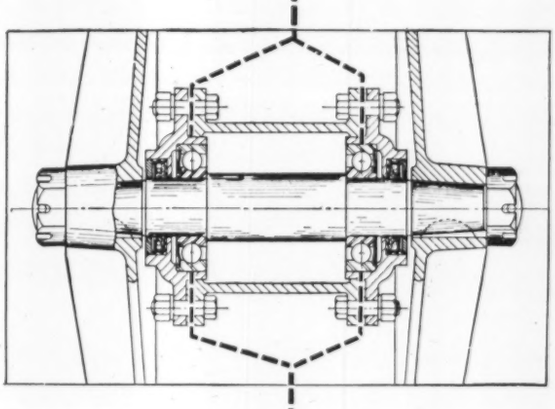
The new pumps are of the rotary, internal gear, positive delivery type with improved stuffing box. Pressures up to 200 pounds per square inch on liquids with fair lubricating qualities are handled. Four sizes are available ranging in capacity from 2 gallons per minute at 300 revolutions per minute to 40 gallons per minute at 1200 revolutions per minute.



Model CP oil pump. End type mounting enables incorporation into machine

Construction features include ball bearings to absorb the thrust and radial loads of the rotor, compactness, and a new standard mounting

SRB *Lubri-Seal* BALL BEARINGS *protect* EUCLID TRACK WHEEL DUMP WAGONS



PULL away the end caps that hide the axle bearings of the Euclid "Track-wheel" Dump Wagon and you will find four sturdy SRB *Lubri-Seal* Ball Bearings. Notice how the built-in shield of the *Lubri-Seal* forms the inner wall of a triple sealing arrangement — an additional labyrinth that prevents any particles of dirt from reaching the bearing chamber.

The built-in shield of the SRB *Lubri-Seal* is an important protective advantage that permits this bearing to give dependable operation under the most unfavorable conditions.

Aside from its operating efficiencies, the *Lubri-Seal* is a money saver. Not only does it decrease maintenance expense but it simplifies the mounting arrangement — requires less parts to form an effective seal — and stops lubrication loss through leakage.

These inherent economic advantages explain why SRB *Lubri-Seal* Ball Bearings are recommended for all types of construction machinery. Information on request.

STANDARD STEEL AND BEARINGS, INCORPORATED
Plainville *Connecticut*
DIVISION OF MARLIN-ROCKWELL CORPORATION

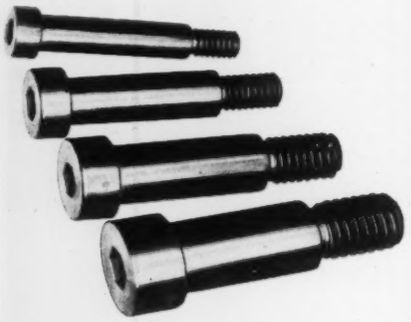
Ball SRB **Bearings**

design, primarily arranged for end mounting with an optional bracket for users desiring foot type of mounting. The end type of mounting makes it convenient for the designer to incorporate the pump into his machine inconspicuously and with a minimum of space.

Operating features include development of pressures up to 200 pounds per square inch; efficiency in performance as high as 70 per cent on good grades of lubricating oil; direct-motor drive at speeds up to 1200 revolutions per minute; maintenance of prime by use of upright ports and ability to drive pump in either direction of rotation, suction and discharge ports interchanging when the rotation is reversed.

Develops Socket-Head Screws

COLD-DRAWN, socket-head shoulder screws recently were placed on the market by Allen Mfg. Co., Hartford, Conn. These screws are stocked in several body diameters and many shoulder lengths adapted for holding together a great variety of machine parts and for cam attachments. The screws are heat-treated and are resistant to wear.



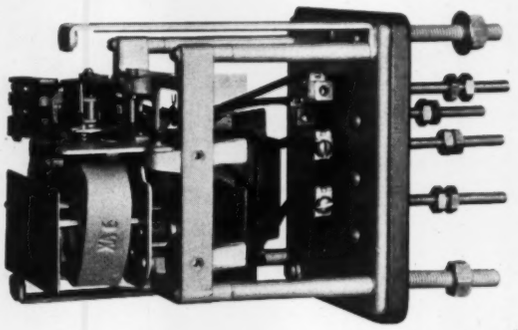
Four sizes of socket-head shoulder screws for machine parts

These socket-head screws are made in four sizes of hexagonal sockets—3/16, 1/4, 5/16, and 3/8-inch across flats. Corresponding shoulder diameters are 3/8, 1/2, 5/8, and 3/4-inch. Shoulder lengths for the 3/8-inch size range from 1¼ to 4 inches; for the ½-inch size from 1¼ to 5 inches; for the ⅝-inch size from 1½ to 6 inches; and for the ¾-inch size from 1½ to 8 inches.

Relay Is Induction Type Unit

FOR undervoltage protection of alternating current circuits, General Electric Co., Schenectady, N. Y., recently announced a new induction relay designated type IAV. It is a single-pole, single-circuit device and has circuit-closing contacts. Applications cover circuits of 600 volts or less and circuits of higher voltages with the 110-volt secondaries of potential transformers. The unit is available for 25 and 60-cycle service.

The new relay has a universal design of rectangular case which harmonizes with switchboard instruments and meters which are now standardized with similar cases. It is only 5½ inches wide. Four such relays may be mounted side by side on a panel 24 inches wide. A glass front and light finish of certain parts permit ready inspection.



Induction relay designed for undervoltage protection, with cover removed

Contacts are self-aligning, the stationary member being individually adjustable and the movable member a silver disk which provides different points of contact. When the relay has operated a target indicator is visible from any front angle.

Announces New Heating Elements

ELECTRICAL heating elements of the immersion type recently were announced by Harold E. Trent Co., manufacturer of electrically heated industrial equipment, Philadelphia. Type IR Junior immersion unit is shown in the accompanying illustration.

Immersion type electrical heating element. Insulation is made up of refractories

These heating elements have been constructed to be interchangeable with other elements

S-T-A-M-I-N-A
Spells "Low-cost Power"

Fairbanks-Morse Type QLS (Line Start)
Ball Bearing Motor

Standing up on difficult drives — stamina! That's what counts in a motor. That's what keeps power costs at a minimum — keeps production moving.

Stamina is built into Fairbanks-Morse Motors. No wonder they stand up when the going is tough. No wonder they give years of trouble-free service. Inspect one of these motors. Notice the heavy, broad feet that anchor it firmly to its job and keep it from "weaving." Look at the sturdy, rigid construction and end bonnets that fully protect the interior elements.

You'll find the same sound construction throughout. A short, thick shaft that takes any torsional strain without deflecting. *Note particularly how that shaft is hung on ball bearings!* This is one of the big reasons for F-M Motor super-performance. These bearings are sealed dust-tight. They require greasing but once a year! The insulation on F-M Motors is impervious to oil and moisture—will not harden or crack under adverse operating conditions.

Let us send complete information about Fairbanks-Morse Motors. Go over F-M construction point by point. See how F-M "Built-in" stamina will help you to keep power costs low. There's no obligation.

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900 S. Wabash Ave., Chicago
32 branches at your service throughout the United States

FAIRBANKS-MORSE
MOTORS

F.A40.36

made of a similar character. Insulation in the unit itself is made up of refractories which are graded in the course of manufacture to permit of a maximum temperature with high dielectric characteristics. The heating element itself is the result of an investigation which determines the correct relationship between the area of the heating element and the outside casing. It has been found in the course of investigation that one of the causes of high mortality for heating elements is due to the surface of the heating unit being too small to radiate the heat generated in the element. Result is the heating element works at not only a too high wattage per square inch, but has not the ability to dissipate the energy developed in itself.

While this unit is made for stock purposes with a seamless brass tube, bodies made of copper, steel, or chrome steel alloy tubes are available. For the ordinary standard elements, the heat is distributed over the entire length of the unit, but when necessary, heat concentration at different positions along the tube can be provided.

Motor Starter Is Explosion Proof

NEW air-break, explosion-proof motor starter known as type E form AAA, and built on the same principle as the Louis Allis explosion-proof motor, recently was placed on the market by Louis Allis Co., Milwaukee. Both units are designed to withstand the force, and prevent the escape of flame from any explosion likely to occur inside the apparatus due to grounds, burn-outs, etc.

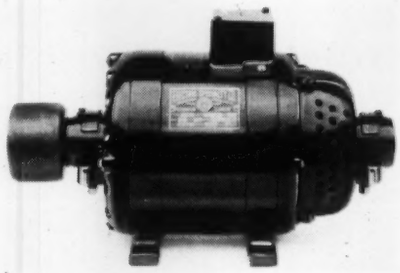
Air-break explosion-proof motor starter enclosed in a heavy cast iron case. The unit is designed to eliminate oil

The new starter, shown in the accompanying illustrations, consists of the usual across-the-line air-break magnetic contactor with overload and under voltage protection. Strength to withstand explosions is provided by a heavy cast iron case, the cover of which is held on by 10 heavy cap screws. Wide machined surfaces, and tight joints between the case and cover, cool and prevent the escape of flame even if explosive vapors enter due to "breathing" and are ignited inside the starter.

Before being placed on the market this switch was submitted to and approved by underwriters' laboratories, where it was subjected to numerous severe tests in which vapors were exploded inside of the case by means of a spark plug, while the switch itself was surrounded by explosive vapors. At no time did any flame escape to ignite the surrounding vapors. The new motor starter is for use in oil refineries, natural gasoline plants, dry cleaning plants, chemical plants, grain elevators, feed mills, or wherever the surrounding atmospheres may be flammable from the presence of explosive vapors or combustible dust.

Designs New Type A. C. Motor

DESIGN for an alternating current synchronous commutator motor, operating with unusually high efficiency and power factor, as well as low starting current, recently was announced by the Electric Specialty Co., Stamford, Conn.



Alternating current synchronous commutator motor

Performance of the unit is in compliance with the recommendations of the joint committee on fractional horsepower motors. The motors are made in sizes from ⅛ to 3 horsepower. Savings in power in one year, resulting from the use of these motors, as compared with the old type induction synchronous unit, may more than compensate for the initial cost of the motor, it is claimed.

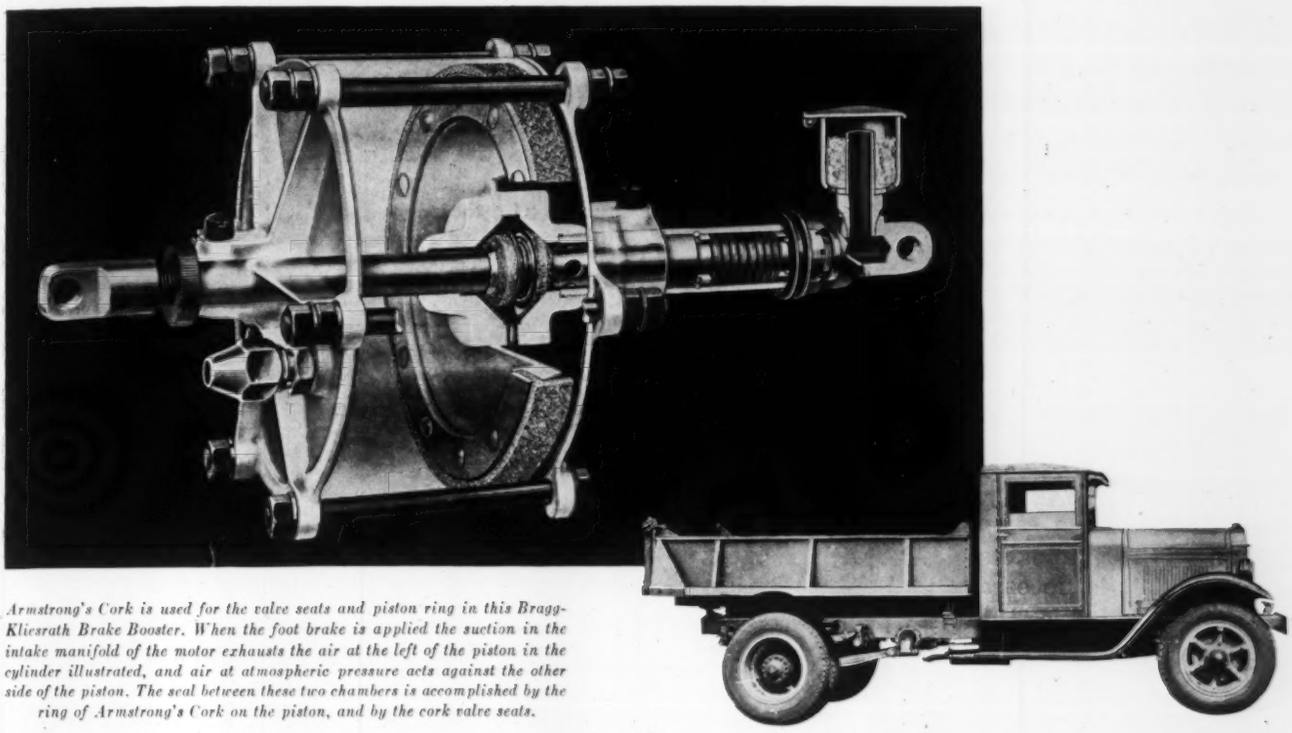
These units are being used by many manufacturers of talking picture projection apparatus, and for other types of equipment requiring synchronous motors. Patent has been applied for.

New Chain Is Side-Guide Type

A NEW type of reversible silent chain has been placed on the market by Whitney Mfg. Co., Hartford, Conn. The chain allows the direction of the shafts to be reversed and will drive on either or both faces. It is particularly

CORK SEALS THE VACUUM CHAMBER

in this BRAGG-KLIESRATH Brake Booster



Armstrong's Cork is used for the valve seats and piston ring in this Bragg-Kliesrath Brake Booster. When the foot brake is applied the suction in the intake manifold of the motor exhausts the air at the left of the piston in the cylinder illustrated, and air at atmospheric pressure acts against the other side of the piston. The seal between these two chambers is accomplished by the ring of Armstrong's Cork on the piston, and by the cork valve seats.

ANOTHER interesting use of Armstrong's Cork is found in this Bragg-Kliesrath Brake Booster used in heavy truck, trailer, and bus service. A piston ring and two valve seats of cork in this ingenious device not only prevent the passage of oil and grease, but actually form such an effective seal that not even air can pass between its two chambers—one a vacuum and the other at atmospheric pressure.

It is a unique property of cork that resistance to the passage of air and liquids is combined with an untiring resiliency. Cork does not harden, shrink, or become brittle. Its cellular, non-porous structure makes it an exceptionally efficient and non-deteriorating sealing material. The exacting service it performs in this Bragg-Kliesrath Brake Booster is proof of cork's effective sealing qualities.

No other material, natural or synthetic, combines to the same extent the properties of cork . . . resilience, compressibility, resistance to liquid and air penetration, low thermal conductivity, chemical inertness, stability, light weight, high frictional efficiency, and low cost.

Designers of machinery and engineers in charge of production are daily making cork solve problems not only of air and oil sealing, but also of vibration cushioning, sound deadening, insulation, friction (both driving and braking), and other troublesome questions. Write for our free book, "Industrial Applications of Cork," which explains the properties of cork and describes the many purposes for which it is employed in industry. Also ask for "Armstrong's Cork for Sealing Anti-Friction Bearings."

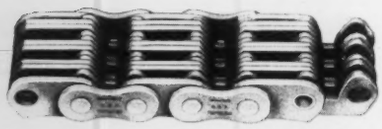
Armstrong's Cork can be formed to your specifications. You are invited to submit your problems to our staff of engineers. Write Industrial Service Section, Armstrong Cork Co., 918 Arch St., Lancaster, Pa.

Armstrong's (A) *Product*

Armstrong's
CORK
MADE TO YOUR SPECIFICATIONS

adaptable to installations where lack of vibration is especially desirable and also where it is desired to drive several shafts in different directions of rotation or to install a chain take-up device to operate on the back of the chain.

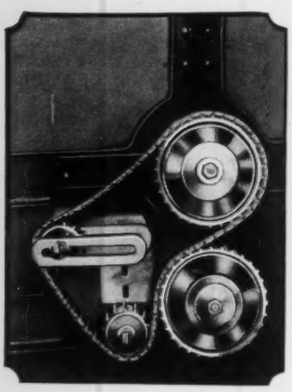
The chain utilizes a double internal chain



Links of the side-guide type reversible silent chain

link and sprocket tooth engagement on either face on one row of links across the chain, with the supporting external engagement of the next row of links on either side of the internal contacting row. This construction gives a combination of the joint load relieving features of the standard single face, automotive, internal engagement silent chain, supplemented by the rigidity and strength of the external method of chain link and sprocket tooth engagement. The side-guide type of chain construction is used. Only chains of an even number of pitches can be used.

In selecting sprockets for use with the reversible chain, it is necessary to choose those with diameters which employ an even number of teeth when designed for the conventional single faced chain, since every other tooth is removed in the reversible chain sprockets to permit the passage of the back of the reverse face links in their travel over the sprockets. This reversible chain is designed to give long life, due to the construction providing full width of joint bearing across the chain, not interrupted and reduced by spacing washers or inside plates. The chain is covered by patents.

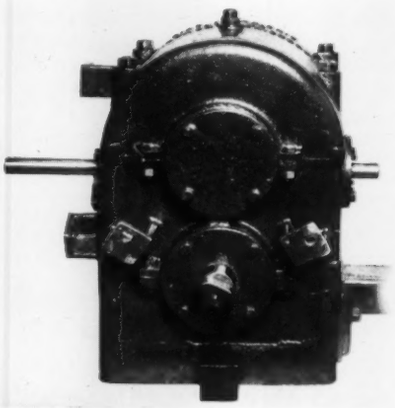


Application of reversible chain which utilizes a double internal chain link and sprocket tooth engagement on either face on one row of links across the chain, with the supporting external engagement of the next row of links on either side of the internal contacting row

Gear Unit Is Fully Enclosed

TWO-SPEED fully enclosed gear unit with dust-proof, split housing recently was announced by Gears & Forgings, Inc., Cleveland. This is particularly adaptable to coal stoker service or other work where a great deal of grit is present. The two speeds are controlled by a conventional ball-and-socket shift lever which operates a double clutch of heat treated alloy steel. This clutch is of the 10-jaw type, facilitating prompt engagement at any speed or load.

The design of the unit, shown in an accompanying illustration, is based on a scientific computation of stresses, and all parts are manufactured to the highest automotive standards. Gears and shafts are of forged nickel steel, heat treated to give maximum toughness and wearing quality and finished by grinding. The worm gear is of special bronze. Gears are accurately generated, and are subjected to a rigid system of inspection, being given a final test on fixtures before assembly into units.



Two-speed fully enclosed gear unit in compact housing

All principal bearings are of the antifriction type, selected for the load at each point, and accurately mounted. The compact housing is reinforced with ribs to give maximum rigidity. Through a unique arrangement of gears, the oil level is maintained below the input and output shaft, thus insuring against any possibility of oil leakage. All gears and bearings are afforded adequate lubrication by a simple and efficient splash system.

Starter Has Trip-Free Handle

ONE of the features of the new class 2510 manual starter recently introduced by the Industrial-Controller division, Square D Co., Milwaukee, is that all poles are simultaneously opened with the tripping of either of the two relays. The thermal overload relay used in this new unit is the same type which is being used in the line of automatic starters. Because this relay is incorporated in the design of the new starter, protection is assured for the motor

A PROMISE

is Only a Prómise . . . . PERFORMANCE is History!

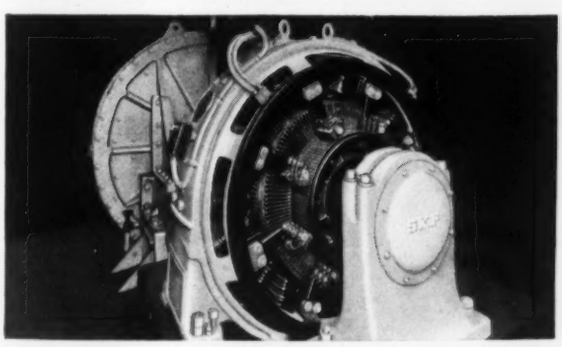
And Performance is the Basis Upon Which Eighty-three Representative Manufacturers of Rotating Electrical Equipment are Selecting SKF Ball and Roller Bearings.

Performance... that's it... performance... in a bearing it's the ONLY thing that counts.

On what other basis should a bearing be manufactured . . . or sold . . . or bought? On what other basis should a bearing be judged?

And so, SKF maintains its own mines from which to get the ores for its special steels . . . its own forests from which to get the charcoal for processing these steels . . . its laboratories at home and abroad . . . its numerous plants everywhere . . . all with the idea of building performance . . . and still more performance . . . into SKF Bearings.

Performance . . . dependable year in and year out performance . . . is the quality that has made SKF the selected bearing of practically every industry in the country . . . and more specifically, the selected bearing of 83 manufacturers of rotating electrical equipment. SKF INDUSTRIES, INC., 40 East 34th Street, New York, N. Y.



Nothing but Performance could have caused the General Electric Company to use SKF Bearings on this electric motor. It drives a great pump, also SKF-equipped, on the U. S. Engineers Department dredge, "Willets Point."

SKF

2632

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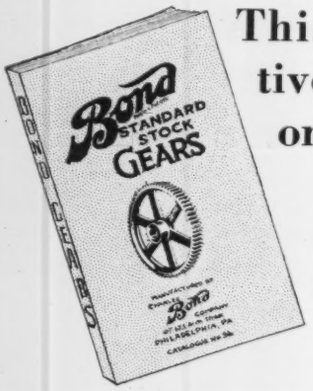
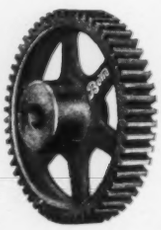


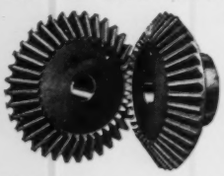
This authoritative Data Book on Gear Standardization is yours for the asking!

Send for it.



Bond Stock Gears have gained the favor of designers, engineers and Industry in general because of their quick and convenient availability.

In the Bond shops are manufactured gears of every description on a quality production basis. Machine designers will find these stock gears and the many distributing points a great convenience when incorporating them in original specifications of design.



Many other points of their desirability in standardization work are told in the new 160-page Bond Stock Gear Data Book. A copy should be on the desk of every designing engineer or person interested in gears. We'll gladly send one on request to any interested party—without obligation, of course. Just ask for Catalog No. 56-D.

There are Bond Stock Gear distributors in many industrial centers.

CHARLES Bond COMPANY

621 Arch St., Philadelphia, Pa.
Gear Manufacturers

Charles Bond Company,
621 Arch Street,
Philadelphia, Pa.

Date.....

Please send new catalog No. 56-D of Bond Stock Gears.

Name.....

Company.....

Address.....

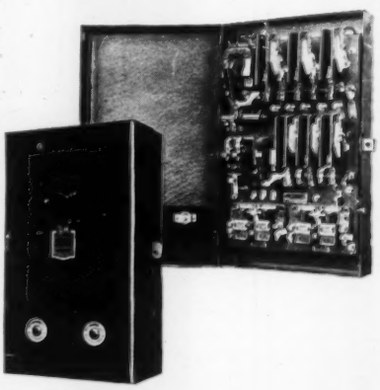
against excessive current, whether due to operating conditions or single phasing of the line.

The starter is reset for operation by pressing the button extending through the front cover. Another feature is its trip-free handle which prevents blocking of the switch closed against an overload, and as the starter is operated entirely from the front it may be mounted in pairs or groups on pedestal or wall without waste space.

The three phase ratings are 5 horsepower, 220 volts and 7½ horsepower, 440-550 volts. It is suitable for looms, pumps, portable conveyors, fans and any application where low voltage protection is not required.

Controller Is Automatic Type

DEVELOPMENT of a new automatic controller for two speed, consequent pole type (reconnected) squirrel cage motors recently was announced by Cutler-Hammer Inc., Milwaukee. This controller, known as bulletin 9739, functions to start the motor and to change its speed by reconnecting the motor windings. It provides thermal overload protection at both motor speeds and low voltage protection. A separate



Automatic controller for two-speed consequent pole type squirrel cage motors. It changes speed by reconnecting the motor windings

push button master switch with "stop," "low," and "high" buttons provides three-wire remote control.

These new controllers are furnished for constant horsepower, constant torque, or variable torque motors. A sequence compelling feature can be furnished which makes it necessary to always start the motor on low speed before bringing it up to high speed.

The entire mechanism is mounted on a single slate panel, which is removed easily from the case by displacing four screws. The split type enclosing case provides easy access to all parts when the cover is opened. Conduit knockout holes are provided in the top, bottom and sides of the case.

IF YOU MANUFACTURE . .

- SMALL CONVEYORS
- DOOR OPENERS
- TEST BENCHES
- WINDOW OPENERS
- PUMPS
- INDICATING MECHANISMS
- VENTILATORS
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- MIXERS
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- TICKET MACHINES
- AIR BLOWERS
- SPECIAL MACHINERY

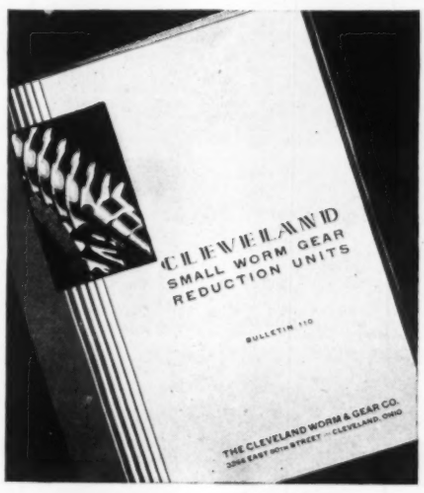
You will want a copy of the latest Cleveland Bulletin No. 110.

WHY? Because Cleveland now manufactures three sizes of small Cleveland units on a quantity production basis that enables us to ship these units **FROM STOCK**, the day the order is received.

UNUSUALLY LOW PRICES

Naturally, costs are cut on a production schedule, and these savings are being passed to Cleveland customers in new revised prices that place all the advantages of the worm gear drive, built with Cleveland quality and according to Cleveland specifications, at prices little more than an ordinary speed reduction unit.

THIS BULLETIN TELLS ALL ABOUT IT



Bulletin 110 gives all the details — ratios, horsepower ratings, prices, and complete specifications. If you use small reducers, either in your product or your plant, you will thank the day you sent the coupon below for a copy of this information. There's no obligation attached—simply sign and mail—now.

CLEVELAND
WORM & GEAR COMPANY

3275 EAST 80TH STREET . . CLEVELAND, OHIO

CLEVELAND WORM GEARING—THE ULTIMATE DRIVE

THE CLEVELAND WORM & GEAR COMPANY
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Please send a copy of Bulletin 110.
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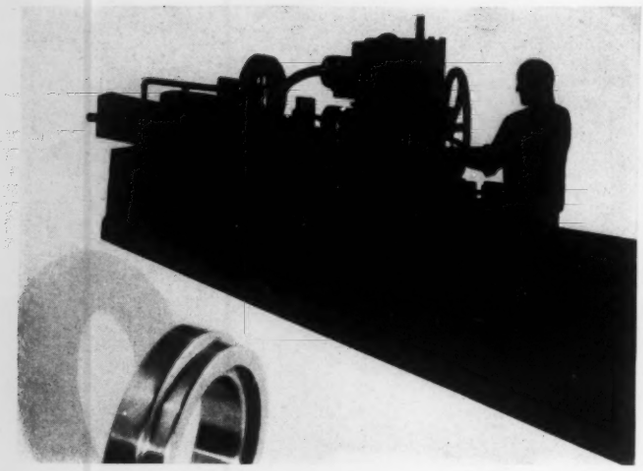


Our mechanical engineers, experts in anti-friction and bearings problems, are at the call of those machine designers who can benefit by such specialized advice. Modern design, tending toward extremely compact, lightweight construction, frequently combined with high loads and speeds, is developing new uses for precision ball bearings. Write to us about your own bearings needs.

Develops New Sheet Dryer of Medium Capacity

MODERATE size blueprints, negatives, blue line and brown line prints up to 24 inches wide are handled by the new Pease "Junior" sheet dryer recently announced by C. F. Pease Co., Chicago. When a chromium plated cylinder is used, it is particularly adapted for drying photo prints. The new dryer, shown in the accompanying illustration, closely resembles the larger size dryers built by the company.

Prints are fed into the machine over a brass scraper rod and up an inclined feed table which drains the water away from the drying drum and prevents steam pockets and creased prints. All surplus water is collected in an adjustable drip pan with drain plug located directly beneath the feed table and this pan can be raised or lowered as required for handling either long or short prints.

Sheet dryer in which prints are fed over a brass scraper rod and up an inclined feed table. Water is drained away from the drying pans and steam pockets are prevented

The revolving copper drying drum can be furnished with either gas or electric heating elements; also, chromium plated when so specified. When equipped with a gas heater, the revolving copper drying drum in the "Junior" sheet dryer contains one burner and can be heated up to proper drying temperature in about three minutes. The dryer is equipped with hand regulated air-mixer valve and consumes approximately 20 cubic feet of gas per hour. When equipped with an electric heater, the drying drum on the "Junior" sheet dryer contains two nichrome wire heating units, each with separate switch, and the drum can be heated up to proper drying temperature in about 10 minutes.

Sturdily constructed with an angle iron frame finished in olive green enamel, the new dryer is equipped with a ⅛ horsepower motor and variable gear drive for two desirable speeds. Overall height of the "Junior" dryer is 5 feet 3 inches and the floor space is 3 feet 5 inches width by 3 feet 6 inches depth.

Modern Machine Designers

Need No Longer Tolerate Grease and Oil Leaks

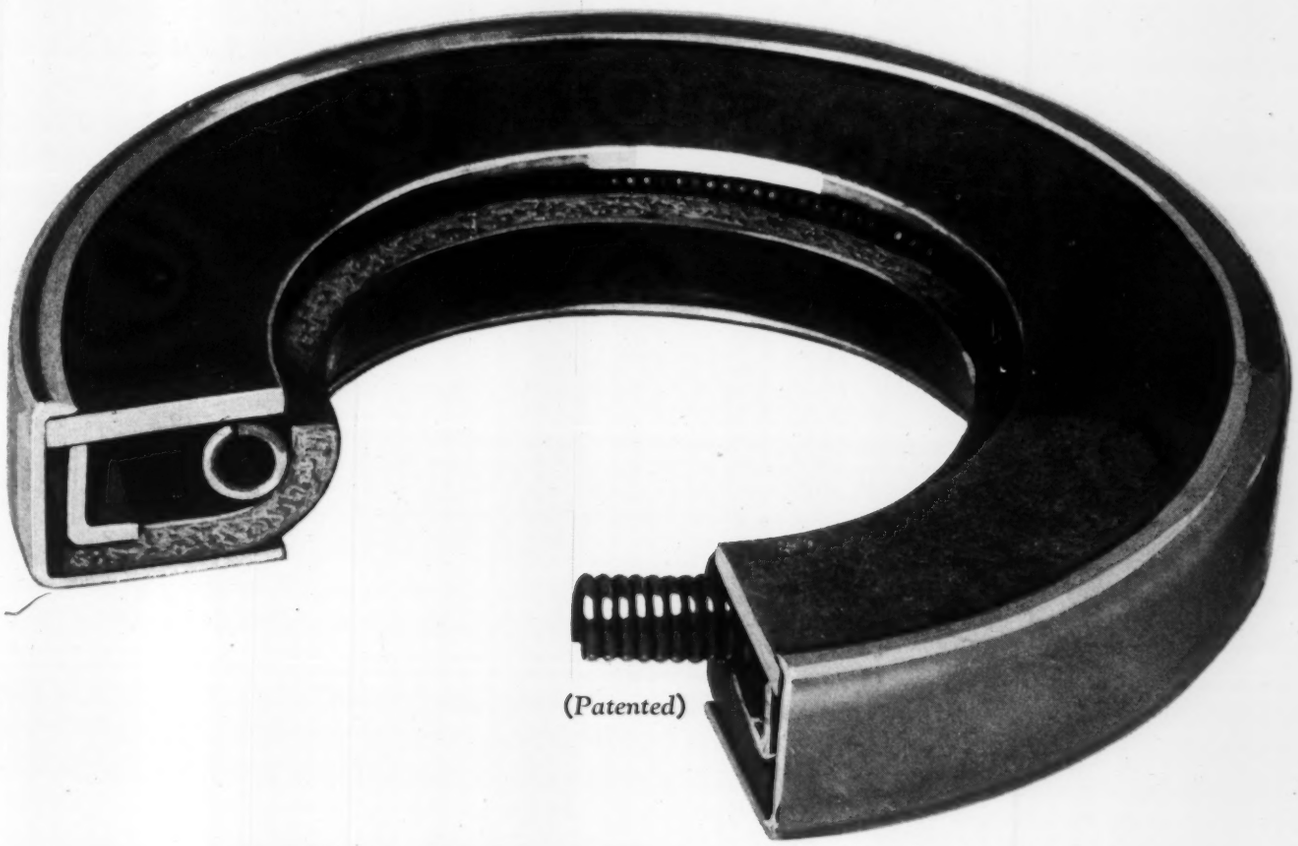
The Perfect Oil Retainer is the modern solution of a problem that has long confronted engineers and designers — the problem of preventing dangerous, disagreeable, wasteful lubricant leaks.

The scientific design of this seal is the result of years of concentration on the development of leather packing devices for the dual purpose of retaining lubricant and of excluding moisture, dust, metal particles and abrasive substances.

The Perfect Oil Retainer is economical because it is delivered as a simple, compact, self-contained unit with the specially tanned leather packing member, spring and pressed steel retainers properly assembled.

The Chicago Rawhide Manufacturing Company

1304 ELSTON AVENUE, CHICAGO, ILL. BRANCHES: New York, Detroit, Cleveland, Philadelphia

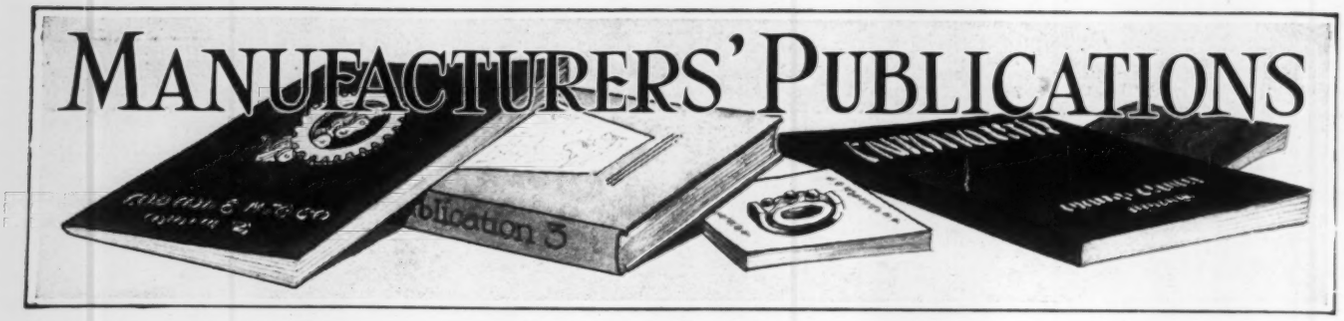


(Patented)

THE PERFECT OIL RETAINER

IF MADE OF LEATHER FOR MECHANICAL PURPOSES, WE MAKE IT

MANUFACTURERS' PUBLICATIONS



Publications listed in this section may be obtained without charge from the manufacturers of the products or through MACHINE DESIGN

GEARS—W. A. Jones Foundry & Machine Co., Chicago, just has issued a 40-page booklet on herringbone cut gears. This publication is complete in that it lists various pitches of gears in three different face widths in both cast iron and steel. Gears are cut by the Sunderland method. Designing engineers will find this booklet extremely interesting and helpful.

LUBRICATION—Five types of mechanical lubricators manufactured by Nathan Mfg. Co., New York, are described in as many leaflets issued by the company. Suitable applications are listed and the operation of the systems outlined. A leaflet on automatic feed oilers gives a comprehensive discussion on the use of this type of lubricator. Interesting illustrations and drawings supplement the text.

GEARS—Charles Bond Co., Philadelphia, recently issued catalog No. 56 containing full data on its standard stock gears. Stock carried by the company provides practically any gear desired and almost any ratio can be obtained in any pitch. List price is included with full details of the stocked gears.

ELECTROPLATING—Aluminum Co. of America, Pittsburgh, recently issued a booklet describing the process of electroplating aluminum. Although written from a production standpoint, it contains much information of interest to the designer. Illustrations supplement the text.

MOTOR STARTER—A hand-operated alternating current starter is described in bulletin 609 by Allen-Bradley Co., Milwaukee. It is designed for use with 5 horsepower, 220-volt and 7½ horsepower 440 and 550 squirrel cage motors. Overload protection is provided.

SPEED TRANSMISSION—An all-metal variable speed transmission, positive, and infinitely variable, is interestingly and comprehensively described in booklet No. 1274, recently issued by the Link-Belt Co., Chicago. Applications to industrial uses are shown and features of construction also are illustrated, including the side-tooth chain operating in contact with toothed disks, giving positive action.

POWER UNITS—Pumps, turbines, compressors and speed reducers are described in a 40-page publication distributed by the De Laval Steam Turbine Co., Trenton, N. J. The publication contains chapters on the characteristics of centrifugal pumps when handling oil and other viscous liquids, on different hydraulic systems of balancing centrifugal pumps, on the effects of skin friction of impellers, and on the influence of the number of stages upon efficiency. A series of charts make it possible to determine the pressure loss due to the flow of oils of various viscosities in 2, 3, 4, 6, 8, 10 and 12-inch pipe lines; also the relation between viscosity and temperature. Various constants, formulas and tables of use to engineers are included.

DRIVES—Cullman Wheel Co., Chicago, has issued a leaflet describing its lathe motor drive unit with belt drive smoothness. Cullman speed reducers also are covered in the text.

ISOLATION—Korfund Co. Inc., New York, in another issue of its booklet "Isolation," presents a discussion on vibration and noise. The publication is devoted to the study and application of sound-proofing and isolation of machine vibration by the use of cork.

MOTORS—A 15-page booklet describing single phase, repulsion induction alternating current motors, type RA, 1/30 to 5 horsepower, recently was published by Master Electric Co., Dayton, O. General specifications are given and full details of construction, supplemented by illustrations, provide the designer with a good understanding of these units.

MOTORS—Reliance Electric & Engineering Co., Cleveland, recently issued a 22-page booklet describing its type T heavy duty planer motors for reversing service. Discussion of direct motor drive, constructional details of the motors and typical applications make up the contents. The booklet is interestingly illustrated.

CASTINGS—Production of dependable castings, which will stand up under strains and serve against heavy wear, is the subject of a leaflet being distributed by the Commercial Steel Casting Co., Marion, O. The suggestion is made that two castings that look alike may be of differing quality.

BALL BEARINGS—Norma-Hoffmann Bearings Corp., Stamford, Conn., in a current bulletin describes its felt-protected anti-friction ball bearings for industrial use. Tables of sizes, dimensions, load ratings and mounting dimensions are given.

ELECTRICAL EQUIPMENT—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued several leaflets, as follows: Universal motors for vacuum cleaners, fans and portable electric tools, adding and calculating machines and various similar devices; single-stage condensate pumps for use where low operating heads are encountered, multistage units being used for applications where high pumping heads prevail.

LUBRICATION—Pennsylvania Lubricating Co., Pittsburgh, has issued a bulletin on automatic pressure lubri-

Greater durability in the transmission of your machine no matter what its *speed*

YOU'VE applied roller bearings wherever possible in the design of the machines you manufacture . . . for high speed, less friction, greater durability, and greater satisfaction to the customer.

The success, everywhere, of the roller-bearing principle is responsible for the ever-increasing trend toward Diamond High Speed Drives . . . and is ample warrant for your use of these Drives in your machines. Diamond Roller Chain Drives stand alone in their immunity to wear, other adverse conditions, and trouble. And their quiet, almost-friction-less action assures a maximum of power transmitted, a minimum of power wastes.

We invite you to investigate the *eight points* of Diamond application . . . *eight* classes of transmission employment where the inherent advantages of Diamond Roller Chain are of particular value to the machine-designer.

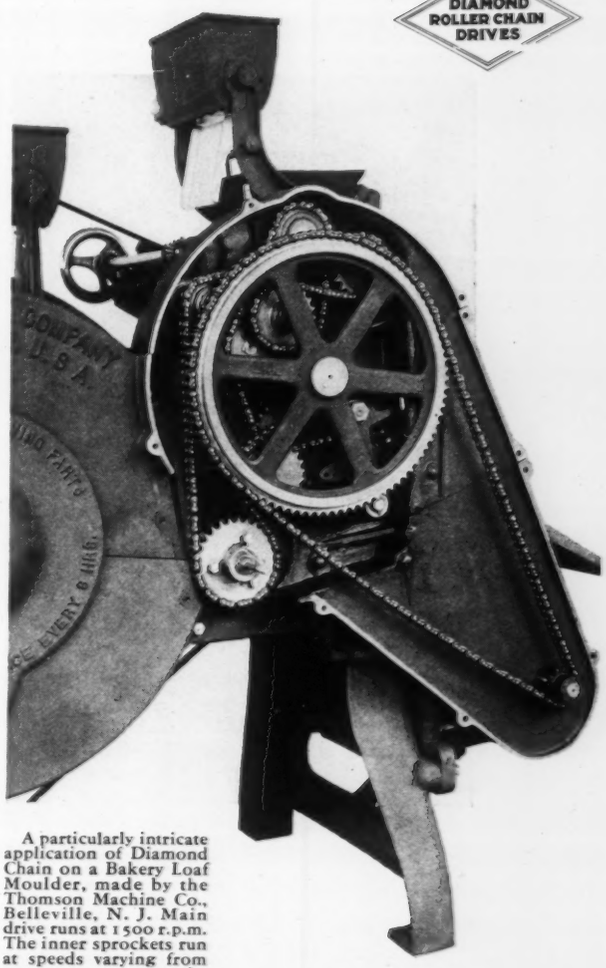
Quiet and Compact

Diamond High Speed Roller Chain is of especial interest to machine-designers. It runs over and under sprockets in either direction; often eight to ten sprockets drive off one chain. It is exceptionally *quiet* . . . *compact*. This superior flexibility, applicability, durability, efficiency often help in the simplification of a design . . . often provide substantial new selling points. The *eight* points of application in machine design are described and illustrated in the new edition of "*Simplifying and Improving Machine Design*"; a copy will be sent to you upon receipt of the coupon.

ROLLING SURFACES DISCOURAGE WEAR

DIAMOND CHAIN & MFG. CO.
435 Kentucky Avenue, Indianapolis, Ind.
Offices and Agents in Principal Cities

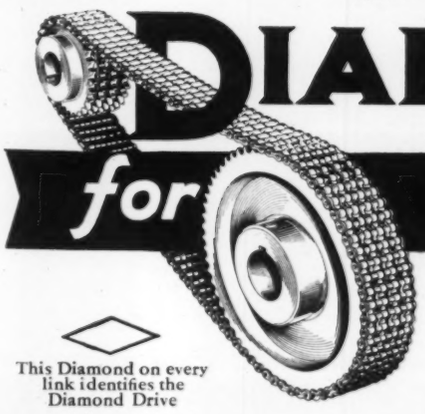
DIAMOND ROLLER CHAIN DRIVES



A particularly intricate application of Diamond Chain on a Bakery Loaf Moulder, made by the Thomson Machine Co., Belleville, N. J. Main drive runs at 1500 r.p.m. The inner sprockets run at speeds varying from 200 to 300 r.p.m., the chain running over and under the sprockets.

DIAMOND ◇ DRIVES

for Every Industrial Need



This Diamond on every link identifies the Diamond Drive

DIAMOND CHAIN & MFG. CO., 435 Kentucky Avenue, Indianapolis, Ind.
Send me a copy of Booklet 104A "*Simplifying and Improving Machine Design*".

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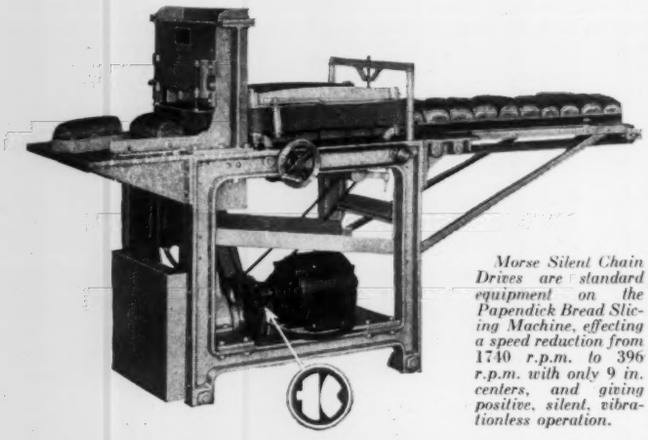
(A-4160)

Do you know how MORSE *stops Power Transmission Waste?*



Morse Silent Chain Drives are standard equipment on the Papendick Bread Slicing Machine, effecting a speed reduction from 1740 r.p.m. to 396 r.p.m. with only 9 in. centers, and giving positive, silent, vibrationless operation.

TODAY'S strenuous competition demands the elimination of waste. Morse *Rocker Joint* Silent Chain Drives stop Power Transmission waste in almost every industry. The following is only one of many reports we have received, telling of savings made.

"We have standardized on Morse Silent Chain Drives for our machines because of their flexibility, which simplifies the setting of the motor; their ability to get proper speed reduction with our desired short centers; their ability to take care of minor shaft misalignments through their flexibility; and their positive, silent, vibrationless operation.

"Not one of the 300 users of our machines has ever complained of any trouble with the Morse Chain Drives. We consider them the most satisfactory drives we could employ for this service, having obvious *advantages over belt or direct geared types of drives.*"

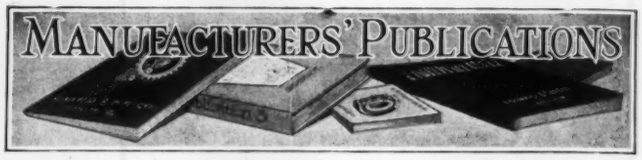
Why not let us show you the advantages which you may gain by using Morse?

MORSE CHAIN CO., Ithaca, N. Y.

Manufacturers of Morse Silent Chain Drives, Flexible Couplings and Chain Speed Reducers

Branches in Principal Cities

Visit the Morse Chain Company exhibits, Booth B-102, American Road Builders Association National Convention, St. Louis, January 10th-16th.



cating systems for roll necks, as part of its engineering service for rolling mills. It contains a historical sketch of the development of modern methods for lubricating these bearings, types of lubricating systems, proper lubricants, design of bearings and reduction of labor. Illustrations supplement the text.

POWER PUMPS—Vertical triplex power pumps are illustrated and described in a current bulletin by the Worthington Pump & Machinery Corp., 2 Park avenue, New York. Various types are illustrated and details are shown. Size and data tables are included.

UNIT HEATERS—Buffalo Forge Co., Buffalo, N. Y., in its catalog No. 469 covers five types of unit heaters for all heating purposes. Illustrations show the units and detailed drawings show construction and operation. Instructions are given to aid in choice of the proper type for a given use.

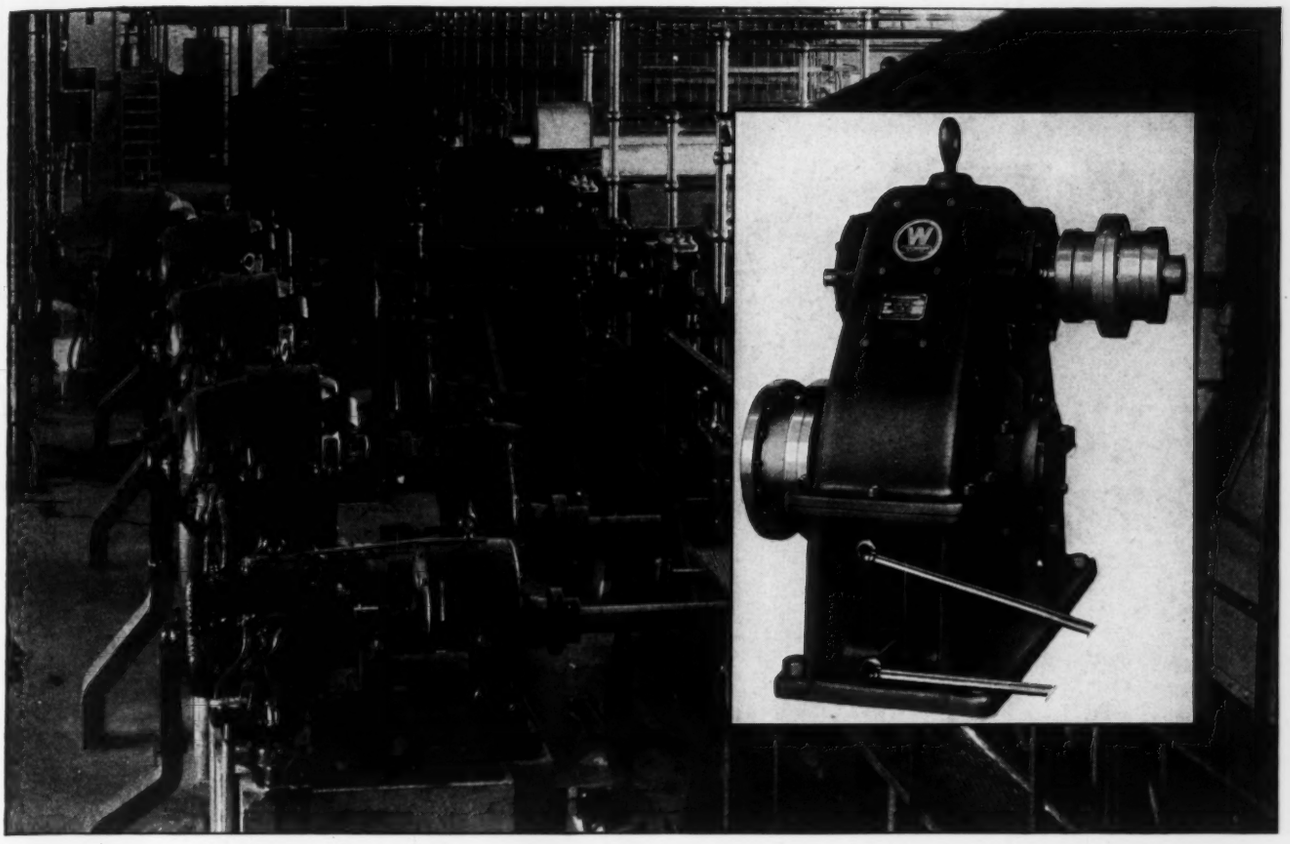
DEMAND METER—For measurement of kilovolt-ampere measurement in connection with analysis of loads the Sangamo Electric Co., Springfield, Ill., has developed a demand meter which is featured in a current bulletin. Illustrations show the meter and all its parts, the principle of operation is discussed and its operation described.

BILLET AND BAR SHEARS—Buffalo Forge Co., Buffalo, N. Y., has issued bulletin No. 330, describing latest features of its line of billet and bar shears with electrically welded frames. Illustrations and tables of capacities are given. Accessories and special equipment are described.

SPROCKETS—A 24-page book prepared by the Link-Belt Co., Chicago., No. 1267, is devoted to sprockets. It contains specifications of sprockets stocked in all standard sizes for immediate delivery. Boring to shaft diameter is the only operation necessary before shipment. A plan of stocking sprockets in all standard sizes to fit popular chains has been worked out.

ELECTRICAL DEVICES — General Electric Co., Schenectady, N. Y., has issued a number of bulletins on various products: Hand starting compensators for squirrel-cage induction motors; magnetic switch; automatic full-voltage controllers; oil circuit breakers; fan-cooled induction motors; explosion chambers; automatic switchgear; photoelectric units; fractional horsepower motors; phase protective panels, and squirrel-cage induction motors.

MOTORS—Westinghouse Electric & Mfg. Co., East Springfield, Mass., recently has issued a new 16-page publication, designated as circular 1883, covering its various types of small power motors. In addition to the text describing the motors, the booklet contains many illustrations showing construction details and applications. Another feature of this publication is a description of the sentinal breaker, a compact starting switch that provides overload protection for fractional horsepower motors.



These Timken Bearings Have Run 70 Times the Life of the Average Automobile

The pinion bearings in the 6 Westinghouse-Nuttall gear reduction units at the Washington Pulp and Paper Company have each rolled up the enormous total of over 2,338,000,000 revolutions, and a recent check-up shows that they are good for many millions more.

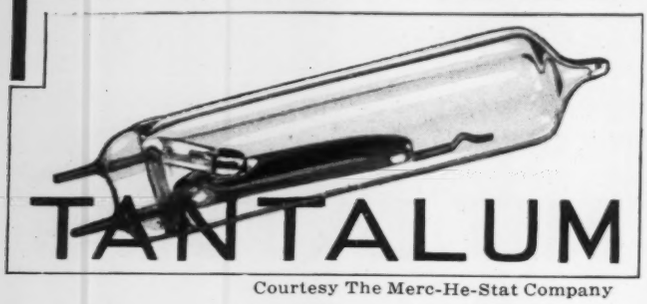
Loaded 100% of their Timken catalogue rating, they have averaged 6¼ days per week, 24 hours a day since they were installed in April, 1923.

The total distance traveled by each of these bearings is the equivalent of driving an automobile more than 3,500,000 miles, whereas the average automobile travels but 50,000 miles during its entire life.

A worthy tribute to Timken stamina! Don't you want this same unequalled endurance in the machinery you design, build or use? The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* **BEARINGS**

FANSTEEL



Courtesy The Merc-He-Stat Company

May improve your product, too

CONTACT with mercury has always been a problem to makers of switches and similar devices. In the switch illustrated above, Tantalum was tried for the small electrode. Result: Heat of operation reduced, current carrying capacity increased and longer life to the switch—all this at very little increase in cost. Tantalum electrodes are now standard with this manufacturer.

Tantalum has other interesting electrical properties. It is an electrolytic valve, rectifying alternating current, and unlike other valve metals, it is *not corroded* by any kind of electrolyte. When heated, Tantalum has remarkable gas-absorbing properties, making it valuable in thermionic tubes. A Tantalum base alloy makes excellent neon sign electrodes.

The Fansteel research laboratory will give you whole-hearted assistance in the development work incidental to improving your product with one of the Fansteel metals. This entails no obligation.

best source of supply

FOR CONTACT POINTS, TOO

Fansteel is your best source of supply for Tungsten or Molybdenum Contact Points, either designed and made especially for your product, or delivered immediately from stock, from a wide line of standard types.

Inquiries invited.

FANSTEEL PRODUCTS COMPANY, INC.

North Chicago, Illinois

TANTALUM • TUNGSTEN • MOLYBDENUM • CAESIUM • RUBIDIUM AND ALLOYS •

Business and Sales Briefs

ANNOUNCEMENT recently has been made that those units of Union Carbide and Carbon Corp. whose products are used in the main for oxyacetylene welding and cutting are marketing their products through The Linde Air Products Co., New York. It now is possible to secure Linde Oxygen, Union Carbide, Prest-O-Lite dissolved acetylene, and Oxweld, Prest-O-Weld and Purox apparatus and supplies through this one company.

This new arrangement has been made for the added convenience and economy of the specifiers and users of these well-known products and will unduobtedly be a popular one. There have been no changes made in telephone numbers or addresses of the distributing stations from which these products have been secured in the past and customers can continue to place their order at these points.

* * *

Southern Tractor Supply Co., 406 Geer building, Durham, N. C., has been appointed exclusive representatives for the sale of Amsco manganese steel crawler tractor links and sprockets in the following territory: District of Columbia, North Carolina, South Carolina, Eastern Tennessee, Virginia, West Virginia.

* * *

Harry S. Ransom has been appointed manager of sales of the Fort Pitt Steel Casting Co., McKeesport, Pa. After a few years' absence from the steel foundry industry, Mr. Ransom returned last spring as special representative of the sales and engineering department at Fort Pitt.

* * *

Bunting Brass & Bronze Co., Toledo, O., announces that 18 additional mill supply houses in leading industrial centers throughout the country have been appointed distributors for Bunting phosphor-bronze cored and solid bars of bearing metal.

* * *

Simonds Mfg. Co., Pittsburgh, has been appointed by the Ramsey Chain Co., Albany, N. Y., to distribute its silent chain drives, sprockets and chain in western Pennsylvania and West Virginia.

* * *

S. Wells Utley, vice president and general manager, Detroit Steel Casting Co., Detroit, was recently re-elected president of Michigan Manufacturers' association.

* * *

Pangborn Corp., Hagerstown, Md., opened district sales offices in Cincinnati and Milwaukee, Jan. 1. Thomas J. Dougherty has been appointed special sales engineer for the Hagerstown district, with headquarters in the home office.

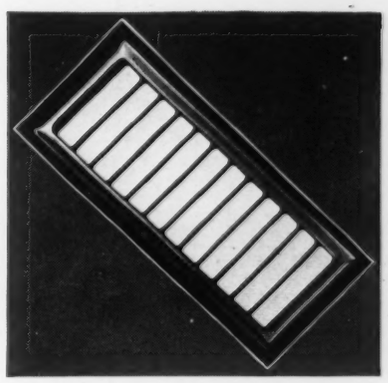
* * *

Merritt P. Whipple, membership secretary of the Rochester, N. Y., chamber of commerce, has resigned to become president of the newly organized Lock-Rite Corp., Rochester.

* * *

S. H. Taylor Jr. has been placed in charge of the Los Angeles offices at 812 Mateo street, of Lincoln Electric Co., Cleveland. He succeeds W. S. Stewart who has been appointed district manager of Cleveland territory. Ap-

DON'T WAIT UNTIL THE RACE IS STARTED . . .



G. P. & F. drawn and punched grille (of 14 U. S. gauge steel) for heating system application. Naturally the smooth finish is desirable for attractive appearance. The light weight and thin cross section would be impossible of attainment except in pressed metal.

FORESIGHTED manufacturers in every field are taking advantage of these quiet days to get fully prepared, *better* prepared, for the bustling days to come . . . when the race for business is on full speed and every advantage counts double.

G. P. & F. are working with the users of stampings in preparation for the race to come. Tools are being prepared, sample stampings from the tools Ok'd . . . everything in readiness for the "break".

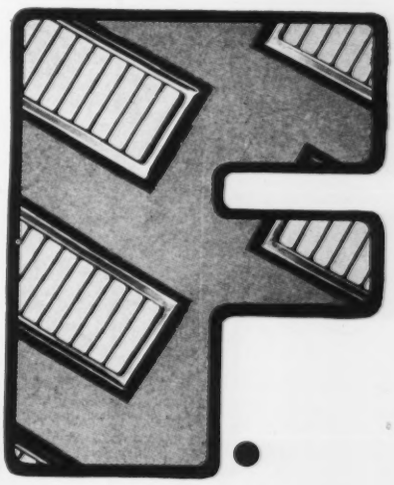
With the background of G.P.&F.'s fifty years' experience in the stamping of countless products, with their huge facilities, their knowledge of every cost-reducing short cut, you can be sure of dies best fitted for the job, of better stampings at lower ultimate cost. And the size of this plant, occupying 19 acres of floor space, assures prompt, speedy delivery of any order.

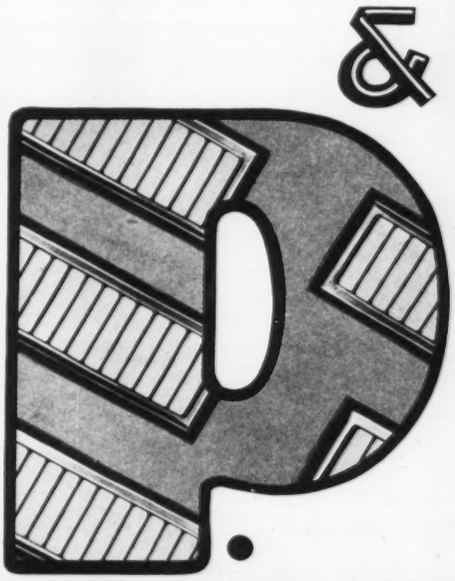
As the first step in preparation mail the coupon for a copy of the helpful booklet "*In Harmony With Modern Progress*". It was written to show manufacturers what can be done with pressed metals—and is sent without charge.

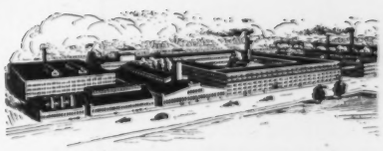
GEUDER, PAESCHKE & FREY CO.

Sales Representatives in Principal Cities in All Parts of the Country

1415 W. St. Paul Avenue, Milwaukee, Wis.
364 W. Ohio Street, Chicago, Ill.







19 ACRES OF FLOOR SPACE

G. & F. STAMPINGS

GEUDER, PAESCHKE & FREY CO.
1415 W. St. Paul Avenue, Milwaukee, Wis.

Please send your new booklet "*In Harmony With Modern Progress*" to the address below . . . without charge or obligation.

Name .....

Company Name .....

Address .....

City ..... *State* .....

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